[redacted]

HumRRO

Technical Report 15 December 1954

MOONLIGHT II:

Training the Infantry Soldier To Fire the MI Rifle at Night

by

Francis E. Jones and CWO William F. Odom

Human Research Unit No. 3, OCAFF
Fort Benning, Georgia

Under the Technical Supervision of

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
operating under contract with
THE DEPARTMENT OF THE ARMY

Task MOONLIGHT:
Experimental Development of Improved Methodology for Training the Infantry Soldier in Night Fighting

MOONLIGHT II:
TRAINING THE INFANTRY SOLDIER TO FIRE THE M1 RIFLE AT NIGHT

by

Francis E. Jones and CWO William F. Odom

Approved:

FRANCIS E. JONES
Director of Research
Human Research Unit No. 3, OCAFF
Fort Benning, Georgia

CHARLES K. RAMOND II
1st Lt, AGC, Acting Chief
Human Research Unit No. 3, OCAFF
Fort Benning, Georgia

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
operating under contract with
THE DEPARTMENT OF THE ARMY

Technical Report 15

Copy 94
December 1954

COMPOSITION OF RESEARCH TEAM

Research planning on MOONLIGHT II was accomplished by a Task Force from Training Methods Division, Human Resources Research Office, The George Washington University, Washington, D.C. This Task Force operated in the planning phase immediately under the direction of Kenneth W. Spence. It consisted of the following members: Francis E. Jones (Task Force Leader), Albert I. Prince, and Joseph S. Ward. In the operational phase of research, the original task force was supplemented by the full-time services of CWO William F. Odom, who acted as military technical adviser to the project throughout, and Lieutenants W. H. Price, Robert Steward, and Albert F. Baker, who acted as project assistants.

Published
December 1954
by
The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
Post Office Box 3596
Washington 7, D.C.

Distributed Under the Authority of
The Office of the Assistant Chief of Staff, G-1, D/A

BRIEF

Research study of firing the M1 rifle under low natural illuminations (starless, starlight, and moonlight conditions) produced the following findings.

Against both dark (simulated maneuver) and flashing (simulated base of fire) targets:

Veterans of night combat firing in Korea were no more proficient than men who had just finished basic training.

Use of auxiliary aids such as a flash hider, or a waxed white string, or both did not improve proficiency.

Use of a special (experimental) method of training in night firing (at an expense of only 14 hours and 62 rounds) increased proficiency from 60 to 210 per cent, depending upon type of target. Exception: moonlight conditions.

Against dark (simulated maneuver) targets only:

Increase of illumination raised firing scores.

Increase in range caused a steady decrement in firing scores.

Against flashing (simulated base of fire) targets only:

Change in illumination had no effect on proficiency.

Change in range had no effect on proficiency.

NOTE: For details of the findings summarized above, turn to pages 21-28 (reading time, less than 10 minutes).

PREFACE

The subject of the present report, "MOONLIGHT II: Training the Infantry Soldier to Fire the M1 Rifle at Night," is a part (Phase 2) of a larger study entitled "MOONLIGHT: Experimental Development of Improved Methodology for Training the Infantry Soldier in Night Fighting."

MOONLIGHT, the larger study, consists of the following phases:

Phase 1. Development of methodology for effectively training the individual infantry soldier in visual night discrimination of targets (MOONLIGHT I).

Phase 2. Development of methodology for effectively training the individual infantry soldier in night firing of the M1 rifle (MOONLIGHT II).

Phase 3. Development and standardization of a transition type of course for simultaneous training of a number of individuals in night firing (MOONLIGHT III).

Phase 4. Development and standardization of a transition type of course for training integral squad-sized units in the technique of fire at night (MOONLIGHT IV).

At the present writing, research on three of the four phases of the larger study is complete, and active field work has just been completed on the fourth phase. MOONLIGHT II is, then, the first of a series of technical reports to cover the various phases of the larger study outlined above. The second phase has been selected for the subject of the first formal written report for two reasons: (1) other on-going research commitments of the personnel concerned obviated the possibility of rendering together reports of Phases 1 and 2 (as was originally planned), and such being the case (2) the contents of Phase 2 were judged to be more crucial for present reporting to the Army than were those of Phase 1 (which will be next reported).

Previously, a preliminary information report of the findings and data of Phase 2 was rendered in conference, first, with the Commandant of The Infantry School and selected members of his staff at Fort Benning, Ga. (9 October 1953), and second, with the Chief of Army Field Forces and selected members of his Office and of Human Resources Research Office at Fort Monroe, Va. (21 October 1953). At both conferences, the user application of these research findings, in the form of a draft of a training circular prepared by The Infantry School for Army Field Forces consideration, was also presented. The training circular was subsequently approved by Office, Chief of Army Field

Forces and by the Department of the Army, and was published by the latter on 22 December 1953 as *Training Circular No. 27*, "Night Firing of M1 Rifle Without Artificial Illumination."

The procedures outlined in Section II (Night Firing Instruction) of TC 27 have been a part of the formal curriculum of The Infantry School since early January 1954. As soon as a range proper to the needs of The Infantry School classes can be constructed, the procedures of Section III (Proficiency Course) of TC 27 will be added.

1 September 1954

ABRIDGMENT

1. **Authority:** (See "The Research Requirement," page 6)

a. **Directive:** (See footnotes 1 and 2, page 6)

b. **Purpose:** To develop a realistic method for "training of individuals to fire effectively at night, particularly with the M1 rifle."

2. **References:** (See Selected Bibliography, pages 35-36, and footnotes 1 and 2, page 4, and footnote 2, page 5)

3. **Background:** (See "Introduction to the Study," pages 3-5)

a. Analysis of fighting against the Japanese in World War II and of the later fighting against the Communists in Korea had revealed a low degree of effectiveness in our nighttime employment of flat-trajectory shoulder weapons generally, and particularly in our use of the M1 rifle. This ineffectiveness was largely attributable to the following difficulty:

(1) Limitation of the utility of standard techniques of sight alignment to the higher illuminations (daylight, to include one-half hour before sunrise and after sunset, and the higher degrees of moonlight), due to inability of the shooter to discriminate his iron sights properly under the lower illuminations (starless, starlight and lower moonlight conditions, and artificial illuminations), resulting in the night firing error (high and left) when the soldier tried to use these techniques.

4. **Discussion:** (See "The Approach to Solution of the Problem," pages 6-23)

a. After detailed examination of all relevant factors the problem evolved into the following considerations:

(1) **Technique:** Development and perfection of an adequate special (night) technique of weapon alignment that was not dependent upon discrimination of the sights by the shooter.

(2) **Training Method:** Incorporation of the adequate night technique of weapon alignment into a method of instruction which was realistic, economical, and effective.

b. Analysis of the task of the shooter at night revealed that development of an adequate special technique of weapon alignment had to proceed within the restrictions imposed by certain shooter requirements. These were as follows:

(1) The shooter must keep both eyes open.

(2) He must keep both eyes high.

(3) He must use a pointing technique.

(4) He must protect his dark adaptation.

(5) He should check and improve alignment from round to round of firing.

c. Further analysis disclosed that any effective instructional method for training in night technique would be obliged to accomplish the following objectives in the order stated:

(1) Show the soldier what he cannot do, and why not.

(2) Show the soldier how he can, and why.

(3) Let him prove he can, for his own confidence and to clinch the training.

5. **Description of Material:** (Appendices A and B, pages 37-53)

6. **Summary of Tests:** (See "Testing the Results of Both Standard and Special Training," pages 21-23, "General Summary of Findings," pages 24-28, and Appendix C, pages 55-71)

a. **Method of Test.** Two hundred infantry soldiers trained only in standard (daytime) techniques of weapon alignment were tested on a criterion course (experimental night firing range) to establish a firm baseline of ordinary performance under nighttime illuminations. After training in special (night) techniques, 100 other infantry soldiers were tested on the same criterion course, and their performance was then compared with that of the 200 men with standard training. Both groups of men tested, the standard (control) and special (experimental), were evenly divided between combat veterans and men just out of basic training. The 200 men of the control group were further broken down into four equal groups of 50 men each for testing the effects of certain firing aids (flash hider and white string). The 100 men of the experimental group were further broken down into five equal groups of 20 men each, so that five different special (night) instructional methods could be tested and compared.

b. **Results of Test.** One special (night) training method (Method B, so called) was outstandingly better than all others. Under it, proficiency as measured in hits on the criterion course (experimental night firing range) amounted to an increase of 60 to 210 per cent over that of the standard (day) method, depending on the type of target engaged (dark or flashing). This method expended 14 hours of training time and cost 62 rounds of ammunition per man. It consisted of three hours of familiarization firing at night to show the soldier how hard it really is to hit targets at night, three hours of corrective firing by daylight with M1 rifles minus sights to show and ingrain the proper correction (low and right) for night conditions, two hours of night vision instruction to explain how to pick up and not lose track of targets at night, and three hours of application firing to convince the soldier that with what he has learned he can be effective at night. In essence, it is a question of showing the soldier what he cannot do, why he cannot do it, how he can do it and why, and then letting him prove he can for his confidence and to clinch the training. Outside of the principal finding just cited, it was further found:

(1) That the auxiliary firing aids (flash hider, white string, and the combination of the two) did not increase proficiency in night firing.

(2) That combat veterans fired no better than did men who had just finished basic training.

(3) That degree of illumination and range were important determiners of proficiency in firing at dark targets, although not in firing at flashing ones.

7. **Conclusion:** Human Research Unit No. 3 concludes that:

a. Special (Night) Training Method B (See all of Appendix B, less Part IV, Day Training in Night Technique) is the most effective method currently in existence for training the individual infantry soldier to fire the M1 rifle under starless and starlight natural illuminations.

8. **Recommendations:** Pertinent recommendations were given in conference to The Infantry School on 9 October 1953. These were implemented in January 1954 when Method B became a standard item in the curriculum of The Infantry School. Pertinent recommendations were given in conference to Office, Chief of Army Field Forces, on 21 October 1953. These received implementation when, at OCAFF recommendation, Training Circular 27 was published by the Department of the Army on 22 December 1953.

MOONLIGHT II:
TRAINING THE INFANTRY SOLDIER
TO FIRE THE M 1 RIFLE AT NIGHT

TABLES

MOONLIGHT II:

TRAINING THE INFANTRY SOLDIER TO FIRE THE M1 RIFLE AT NIGHT

Chapter 1

INTRODUCTION TO THE STUDY

HOW THIS STUDY CAME ABOUT

Historical Setting

Up until the time of World War II nearly all of the military powers had found it unnecessary to devote much emphasis to the problem of night fighting. Inherent difficulties of command and control under darkness, and of the accurate utilization of fire power, had relegated night operations to a strictly limited and minor role.

Among the powers, however, there was one notable exception. In the early 1930's the Japanese had begun to challenge the premise. While recognizing the difficulties inherent in night operations, they nevertheless estimated that great practical familiarity with the night situation would, relatively at least, convert these same difficulties to advantages.[1] As is well known now, the early successes of the Japanese in World War II, at Hong Kong, Singapore, and Corregidor, in Malaya, the Philippines, and Burma, and in other places, were greatly facilitated by their prior mastery of night operations.[2]

Of necessity, out of coping with the continuing menace of the Japanese in this respect throughout World War II, and later with the same situation as regards the Communists in Korea, the United States Army was obliged to devote more and more attention to the night fighting problem. Satisfactory techniques for efficiently handling the fires of curved-trajectory weapons at night were developed at an early stage in our operations. Even the problem of effective utilization of flat-trajectory weapons was solved in part and to a degree, but satisfactorily only for those employed from fixed mounts. On until the time of the truce in Korea, the great hiatus in our nighttime effectiveness continued to be the lack of efficient use of flat-trajectory shoulder weapons. In pursuit of the training mission assigned him, this particular part of the night fighting problem had become a matter of grave concern to the Chief of Army Field Forces early in 1952.

More Recent Developments

Initially, the problem of developing a means to improve the night firing capability of the individual infantry soldier was presented to The Infantry

[1]See Selected Bibliography, reference 5.
[2]See reference 18.

School, Fort Benning, Ga., by representatives of Army Field Forces on 12-13 August 1952. A visit to The Infantry School by the Inspector of Infantry on 25-26 August 1952 verified the fact that The Infantry School was working on the problem, and this was later confirmed by a visit of a staff member of the Weapons Department of The Infantry School to Army Field Forces on 8-12 September 1952.

In September it was discovered that the development of a night sight for the M1 rifle was a major problem in night firing. Army Field Forces Board No. 3, Fort Benning, was at this point directed to study the problem.[1]

A staff member of the Training Methods Division, Human Resources Research Office, was briefed by Army Field Forces on the training aspects of the problem, with their implications, on 2 December 1952. It was tentatively agreed that HumRRO would submit a research proposal based on the requirements outlined, and on 16 January 1953 the Assistant Chief of Staff, G-3, Office of the Chief, Army Field Forces recommended that a formal project be initiated with HumRRO to develop means of improving the ability of the individual soldier to fire his rifle at night.[2]

RELATED STUDIES

Other studies related to MOONLIGHT II[3] fall into one or another of four different but closely allied areas. These are (1) night detection, (2) night vision training, (3) night sights, and (4) night delivery of fire.[4]

(1) Studies in Night Detection. The first problem in night firing is the detection of targets. The most pertinent published studies were those of Rostenberg and of Uhlaner,[5] both of which concern validation of the Army Night Vision Tester against outdoor criteria. The data taken on the criterion situations were of particular interest. However, they were limited in value because of the nature of the targets employed, which were different, for the most part, from those utilized in MOONLIGHT I and in this study.

Unpublished related studies were MOONLIGHT I and "Artificial Moonlight," the latter a study being conducted at Tulane University, New Orleans, La., under contract with the United States Army Engineer Research Laboratory, Fort Belvoir, Va. MOONLIGHT I provided a firm baseline of detection ability under various low natural illuminations for infantry (human) targets. Artificial Moonlight was and is, among other things, a project aimed at the same objective as was MOONLIGHT I, but concerned with artificial illuminations. As yet, no data are available from the latter.

(2) Studies in Night Vision Training. The second problem in night firing is the maximization of target detection ability through training. Of principal interest in this area, among published studies, were the review of training

[1] Basic Letter ATDEV-11 474, from OCAFF to President, AFF Bd No. 3, dated 3 October 1952, Subject: "Requirement for a Night Firing Sight for the M-1 Rifle."

[2] DF CN57394, from ACofS, G-3, OCAFF to RD-8, OCAFF, dated 16 January 1953, Subject: "Night Firing M-1 Rifle."

[3] See Preface for description of the four phases of Task MOONLIGHT research.

[4] See the Selected Bibliography.

[5] See references 14 and 19.

studies by Sharp, Gordon, and Reuder and two reports of the Working Group on Night Vision Training of the Armed Forces - National Research Council Vision Committee.[1] A conclusion from the review of training studies provided a sound basis for the MOONLIGHT I research. This conclusion was, to quote: "No evidence is available on the effectiveness of a night vision training program as evaluated by performance in an actual field situation. An experiment evaluating these programs would supply very crucial information which is at present missing." On the other hand, the two reports from the Vision Committee provided sound advice as to the content and conduct of proper night vision training. The only pertinent unpublished study was MOONLIGHT I, which provided basic information on the gains to be expected from several types of training.

(3) Studies on Night Sights. The third problem in night firing is the bringing together of man and rifle through use of proper sights. In this area the review of tests conducted by Army Field Forces Board No. 3 (and its predecessor, The Infantry Board) was especially helpful.[2] The conclusions from this review had direct bearing on research done under MOONLIGHT II, for they clearly indicated, at least implicitly, the need for development of new training techniques in laying on the target—techniques that would be independent of the rifleman's ability to discriminate his sights (as is necessary in ordinary aiming). Also of interest were the report of testing of phosphorescent night sights at Fort Dix, N.J., a laboratory study by Warden, and an article in The Infantry School Quarterly by Humphries and Livengood.[3] The last reference cited reports the results of informal tests of different sized sights at The Infantry School. From consideration of all these studies, it could be safely concluded that any early solution of the night firing problem through change of sighting equipment alone was, for practical purposes, unfeasible.

(4) Studies in Night Delivery of Fire. The fourth problem in night firing is the development of proper techniques and training methods in the delivery of fire. Of chief interest here were reports of studies conducted by The Infantry School and by the 9th Infantry Division, Fort Dix.[4] These provided the essential bases in technique for two of the experimental training methods employed in MOONLIGHT II. Additionally, the findings at Fort Dix concerning the night firing error, and the work done there on development of the Night Firing Error Demonstrator, were extremely useful to the present study.

[1] See references 15, 4, and 20.

[2] (1) GNBCG 473.85 (3 Oct 52), 1st Indorsement, from AFF Bd No. 3 to Chief, AFF, Attn: ATDEV-11, Subject: "Requirement for a Night Firing Sight for the M-1 Rifle"; (2) GNBCG 473.85 (3 Oct 52), 3d Indorsement, from AFF Bd No. 3 to Chief, AFF, Attn: ATDEV-11, Subject: "Requirement for a Night Firing Sight for the M-1 Rifle"; and (3) GNBCG 474 (31 Oct 52), 1st Indorsement, from AFF Bd No. 3 to Chief, AFF, Attn: ATDEV-11, Subject: "Heaton Night Sight for M-1 Rifle."

[3] See references 6, 21, and 3.

[4] See references 11, 6, 9, 7.

Chapter 2

REQUIREMENT AND APPROACH

THE RESEARCH REQUIREMENT

The military requirement for MOONLIGHT II was for training research pointed toward the objective "training of individuals to fire effectively at night, particularly with the M1 rifle."[1] In the research plan submitted by the Director, Human Resources Research Office and subsequently approved by the Chief, Army Field Forces, this objective was rephrased "to provide a reliable methodology, validated on the best available criteria, for teaching the individual infantry soldier to better shoot at night with his primary weapon, the M1 rifle."[2]

THE APPROACH TO SOLUTION OF THE PROBLEM

The approach to solution of the problem stated as the research requirement for MOONLIGHT II consisted of three steps:

(1) Building a criterion course upon which to measure and to differentiate realistically and accurately, the varying night shooting skill levels of groups of soldiers that were differently trained, as well as to do the same for individual soldiers within such groups

(2) Devising several realistic methods of training in night delivery of fire, within the frame of practically feasible time limitations and ammunition expenditures, with the aim of arriving at the best single method possible

[1](1) Basic Letter ATDEV-8 353.1, from OCAFF to ACofS, G-3, D/A dated 2 February 1953, Subject: "Requirement for Training Research in Night Vision and Night Firing," especially par. 1b; (2) DF G-3 353 (2 Feb 53), from ACofS, G-3, D/A to ACofS, G-1, D/A, dated 11 February 1953, Comment No. 1 on Basic Letter, Subject: "Requirement for Training Research in Night Vision and Night Firing," especially par. 2; and (3) Letter G-1 353 (11 Feb 53), from ACofS, G-1, D/A to Director, HumRRO, dated 17 February 1953, Subject: "Training Research in Night Vision and Night Firing," especially par. 1.

[2](1) Letter Director, HumRRO to Chief, AFF, Attn: RD-8, dated 19 February 1953, Subject: "Training Research in Night Vision and Night Firing," with Inclosure ("A Proposal for Experimental Development of Improved Methodology for Training the Infantry Soldier in Night Fighting"), especially par. 2; and (2) Letter ATDEV-8 470 (19 Feb 53), from OCAFF to Director, HumRRO, dated 25 March 1953, 1st Indorsement to Letter, HumRRO to OCAFF, Subject: "Training Research in Night Vision and Night Firing," especially par. 1.

(3) Testing results of both standard (day) and special (night) training methods by measurement upon the criterion under various conditions of darkness, together with consequent comparison between the groups so tested, in order to ascertain reliably which method was the best. The steps are more extensively developed in the following paragraphs.

Building the Criterion

From library study of existing literature on the subject of night delivery of fire, and from field study of current operational procedures relating to the measurement of night firing proficiency, together with examination of existing courses, it was determined that no adequate criterion course was either in existence or foreseeably contemplated. The necessity for building such a criterion instrument from "scratch" was therefore apparent. The adequacy requirement for such a course demanded that (1) the proper types of targets be included at the practicable ranges to serve the illuminations involved and (2) the whole instrument be so put together that it would discriminate, both validly and reliably, a continuum of night shooting skill levels ranging from the very low to the extremely high.

Illuminations Involved

The illuminations specified for consideration in MOONLIGHT II were the nighttime levels of natural illumination, varying from those characteristic of moonless, overcast nights on the one hand to those characterized by clear, full-moon conditions on the other. Of the specified continuum of illuminations, the lower part (consisting of levels of quarter moon and less) was considered more crucial, and hence was to receive more stress in the research.

Kinds of Targets

The varieties of targets that may be effectively engaged by M1 rifle fire at night are limited in scope but important in nature. From the standpoint of the rifleman and his mission, there can be little doubt that the most dangerous targets, as well as the most vulnerable, are those characteristic of enemy infantry formations, either on the move or at least exposed enough to deliver fire from flat-trajectory weapons. Visually, such targets are of two general types: (1) dark targets, both moving and stationary, that are characteristic of enemy maneuver elements and (2) flashing targets, usually stationary, that are characteristic of enemy base of fire elements. Both of these general types of targets were selected for inclusion in the criterion course.

Other types of exposed enemy infantry targets were considered but rejected. For example, some targets are heard but cannot be seen. Owing to the vagaries of auditory localization, these are not apt targets for aimed fires delivered on the accuracy principle; they are generally better dealt with by use of some variation of the area fire principle, and hence even by another type of weapon. Still other types of targets were considered, but all were finally rejected because it was decided that other weapons would be more effective against them.

Ranges to Targets

On the basis of individual combat experience of OCAFF staff members, continuing study of combat reports, and consideration of the results of practical tests run at various Army training posts, it was generally agreed by the sponsor of this research (G-3 Section, OCAFF) that the practicable ranges for engagement of dark-type targets by M1 rifle fire were limited to those between 0 and 75 yards, for the levels of illumination prevailing at night. The results of MOONLIGHT I and the MOONLIGHT II pilot studies in night firing strengthened this contention, and it was decided to utilize dark targets on the criterion course within these limits of range. It was conceded, however, that flashing targets probably could be engaged with profit at longer ranges.

Directions of Movement for Dark Targets

In the case of dark targets considered as moving within the horizontal plane,[1] the many possible directions of target motion[2] were examined. As limiting cases there may be (1) motion straight inward or outward (along the normal line of sight of the firer) or (2) motion directly across the front (perpendicular to the normal line of sight of the firer). Between these limits, there may be (3) motion obliquely inward or outward (at any angle other than zero or 90 degrees to the normal line of sight of the firer).

From the viewpoint of the rifleman, the limiting directions—the inward-outward and the crosswise motion—differ markedly in two important respects. Assuming any given constant target speed, motion straight inward or outward presents the greatest difficulty in detection but the least difficulty in laying. Contrawise, motion directly across the front (either from the left or from the right) minimizes the detection difficulty but maximizes the laying difficulty. All other directions of motion between these limits are intermediate with respect to both difficulties. Thus if the proficiency of the firer is measured at each limit of direction of motion, his proficiency at any intermediate direction of motion may be gauged by appropriate interpolation between his measured scores.

Further, since targets are vague at night (for the most part they must be viewed with peripheral vision in order to be picked up and followed successfully), changes in apparent size accompanying direction of motion straight inward or outward are less noticeable for small changes in range than is true (with strictly foveal vision) by day. In addition, the range error in laying for small changes in range is negligible for the short ranges practicable at night. For these reasons, the effect on night firing proficiency of motion inward or outward can be adequately tested by use of a series of stationary targets set out at intervals in depth of 10 yards.

It was decided, therefore, that only one actual direction of motion was needed for dark targets on the criterion course—namely, motion directly across the front of the firer. This decision assured the greatest possible simplicity, and consequently the least expense, in constructing moving target installations for the criterion range. At the same time it gave reasonable assurance

[1] I.e., the plane of the earth's surface tangent to the firing position.
[2] I.e., rectilinear motion relative to the normal line of sight of the firer.

that all directions of rectilinear motion could be covered in the resulting measurement of proficiency—either by empirical (actual) or calculated (interpolated) scores.

The Individual Night Proficiency Course (Experimental Night Firing Range)

The firing line was at ground level, not elevated, and had six places at lateral intervals of 20 yards (Figure 1). Each place was marked by a white stake, driven to a height of about one foot above ground level.

Six moving targets were placed in echelon from the left at ranges of 25, 35, 45, 55, 65, and 75 yards, respectively. Each of these targets was an M-type pasteboard silhouette painted flat black, car mounted on standard track, and hand reel operated to simulate a maneuvering enemy infantryman. Each moving target installation was centered on its respective firing place. Each such installation occupied 12 yards of space parallel to the firing line, with 10 yards of effective target motion—either from left to right or from right to left. Targets were moved uniformly at the speed of a man walking. When stopped at its center position, each moving target served also as a stationary target at that particular range. Tracks and carts were buried in trenches so that the feet of the targets always appeared at ground level.

In addition to the dark-type targets, there were six stationary targets for simulation of small arms fire by flashes.[1] These were mounted en echelon from the left at ranges of 85, 95, 105, 115, 125, and 135 yards, respectively. Each target was an E-type pasteboard silhouette painted flat black, modified to receive a small red light in its center, and mounted in a sunken canister the upper end of which was flush with the ground. These targets also were centered upon their respective firing places. The flicker of all flashing targets was controlled simultaneously, to simulate the intermittent (short burst) burp gun fire of an enemy base of fire infantryman.

The hand reels that controlled the moving targets and the master switch that controlled the flashing targets were located 60 yards behind the firing line. This distance served to cut down the auditory cues afforded by operation of the reels and master switch.

The natural cover—short grass and occasional low weeds—was left on the ground between firing line and targets. Minor irregularities existed in the terrain; it was not levelled, as on ordinary known-distance ranges. Background for the targets was afforded by a distant tree line, which was fairly irregular. None of the flashing targets could be seen in outline under the illumination test, but part of each dark target was silhouetted against the sky to a prone infantryman on the firing line. The skylined part varied fairly uniformly from about 50 per cent of the area of Number 1 to only a small part of the head of Number 6. It was possible to confuse the skylined parts of targets with irregularities in the background.

Since the range was located far from major sources of light, such as the main and subsidiary posts at Fort Benning and the town of Columbus, contrast between targets and sky was reduced to a practicable minimum. Locally

[1] Dark targets and flashing targets were not fired at upon the same occasion. When one type was being utililized, the other was taken down and removed from the range. Such an arrangement provided for the utmost economy in range space.

light was controlled by blocking off the road upon which the range was situated and by insisting otherwise upon strictly blacked-out conditions, except for limited use of red flashlights in the scoring of targets.[1]

SCHEMA OF CRITERION COURSE

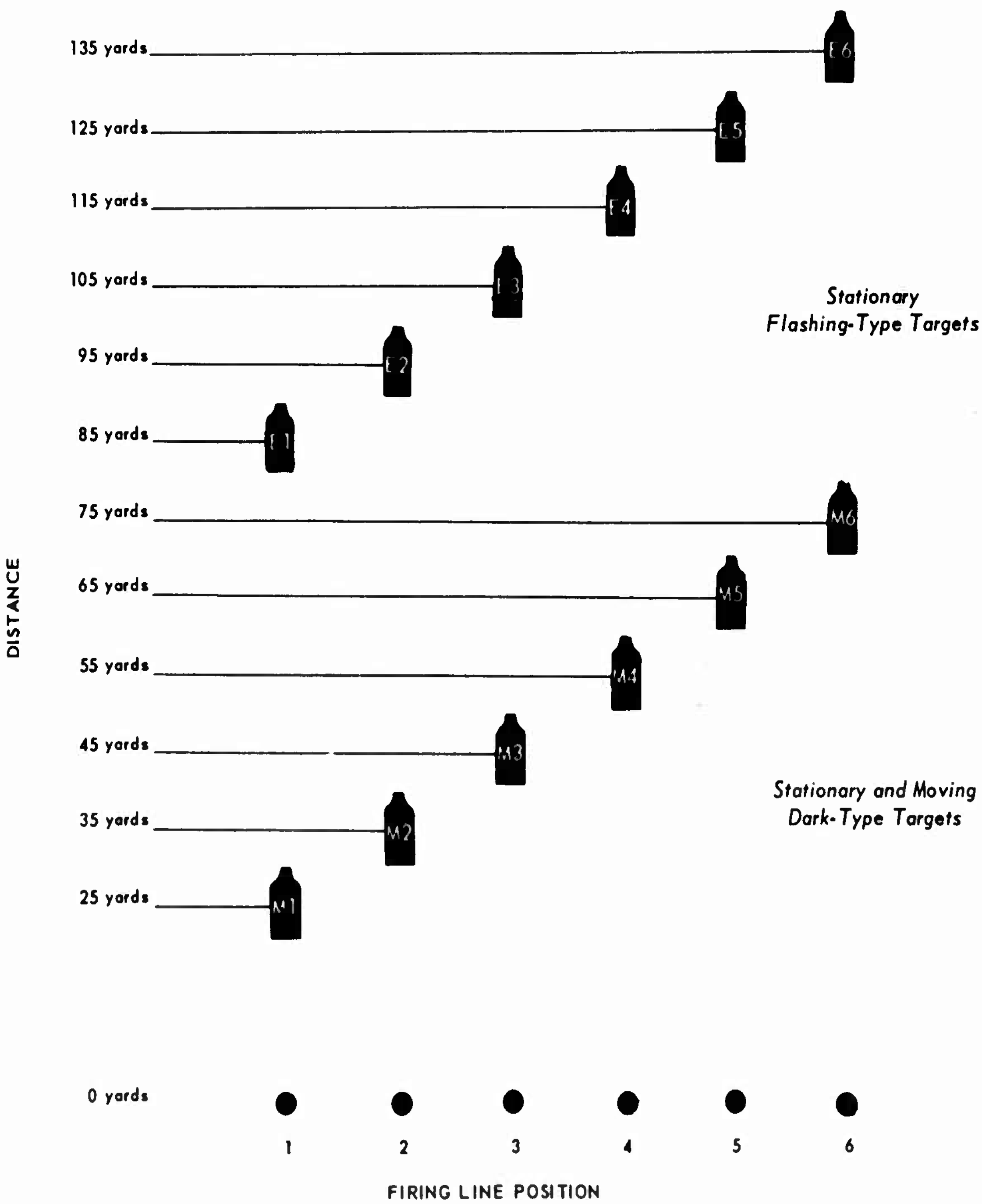


Figure 1

[1]See Appendix A for further details of the operation of this range. For details of construction of the range's component parts, see Army Training Circular 27 (reference 12), and especially Figures 4 and 5 therein.

Devising Realistic Night Training Methods

The sighting system to be used is a crucial factor in the development of successful methods for any kind of training in firing the rifle, either night or day. Assuming an acceptable accuracy of the weapon itself, the sighting system provides the basis for bringing man and weapon together to accomplish the shooting task. Before even beginning to devise effective training methods for night delivery of fire, therefore, it was necessary to determine what sighting system would generally prevail in satisfaction of the night requirements. For this reason the sighting systems now possible were examined and the probability of general use was estimated for each system.

Introduction to the Problem

With the modern military rifle, such as the M1, a high degree of inherent accuracy has been built into the weapon itself. This accuracy is only potential, however; it becomes actual when and only to the degree that a highly trained shooter utilizes an efficient sighting system to its maximal capacity—as witness the Camp Perry rifle matches.

So far as target shooting is concerned, the daytime accuracy requirement of the combination of gunsight and man would seem to have been fully exploited, at least in certain cases, by the training methods current in the Army and the Marine Corps. A serious question of whether this training suffices to transfer to the battle type of day target may be, and from time to time has been, quite legitimately raised. Its transfer to night shooting, where fire is delivered under extremely low natural illuminations, however, is not in doubt—it has definitely failed under many and varied conditions of test. The failure is due to the fact that the prevalent sighting system (iron sights—peep and blade) cannot be sufficiently discriminated under these illuminations and hence cannot be normally used.[1] It was this lack, and its serious consequences in action against enemies who are forced or prefer to fight mainly at night, which prompted the Army to seek an alternative solution to that of attempting to utilize day techniques under illuminations for which they were never designed and are consequently inefficient.

The solution sought is naturally limited to certain general possibilities: (1) to change the sights on the rifle, (2) to change the training of the soldier, or (3) to change both.[2] Why the Army decided to concentrate on research on the second general possibility will become clear from consideration of the paragraphs immediately following.

(1) Changing the Sights

Numerous attempts to change the day sighting system to meet nighttime requirements have been made.[3] Generally these fall into two classes: substitution of an optical system for the present iron sights, or modification of the present sights.

[1]See reference 21.

[2]This of course leaves out of account the obvious general possibility of artificially illuminating the battlefield to such an extent that day sighting systems will work at night. While for limited areas this is no doubt a feasible solution, it is assumed that there will never be enough artificial illumination for every soldier on every part of a wide front.

[3]See references 2, 3, 6, 11, and 21. Also see correspondence cited in footnote 2, page 5.

The first class of solution has met with greater success than has the second. For example, the use of an infrared light source and an electronic telescope mounted on a carbine (the sniperscope) does, at least under ideal conditions, satisfactorily simplify the problem of shooting in the dark.[1] This, however, is not a general solution. Factors such as high initial cost, added weight, potential obscuration, lack of ruggedness, and difficulty of maintenance relegate the system cited to the role of special-purpose equipment. Besides, such a system does not meet day requirements. Except for the last point, these are general faults, to a greater or lesser degree, of any optical system.[2]

Modifications of the present iron sights with the aim of making them more discriminable to the shooter have also been tried.[3] Such attempts have ranged from making peep and blade larger,[4] to efforts to identify the sights for the shooter by use of such means as luminescent paint, controlled points of light and the collimator principle.[5] Various size combinations of open-type sights have been tried, with and without luminescence.[6] All these have failed under the lower light illuminations. In the cases of both luminous and illuminated sights, the failure resulted principally from the glare effect when the sights are lighted but target and surrounds are not. This glare effect causes the target to be lost to the shooter.[7]

For the reasons cited, then, acceptance for general use of any of the changes in the day sighting system reviewed in this section had to be estimated as an extremely unlikely probability. This finding would seem to rule out, prima facie, the first and third general possibilities—changing the sights on the rifle or changing the sights and the training—as solutions for the night firing problem. This made it necessary to consider the remaining alternative solution, changing the training only.

(2) Changing the Training

Considered together, the general shortness of night ranges (imposed by difficulties of target detection under low natural illuminations) and the consequent flatness of night trajectories for the rifle suggest that another type of approach may be more successful than one involving change of the day sighting system. Admittedly, for the long ranges and high accuracy requirements of day firing, the weapon must be precisely aligned upon the target, both in deflection and in range, or misses will ensue. But for the short ranges and consequently lower accuracy requirements of night firing, alignment of the weapon can be more approximate and hits will still be possible.

Therefore, if some adequate method of weapon alignment not dependent upon discrimination of the sights by the shooter could be devised, and its teaching were practicably feasible, the night firing problem would be open immediately to solution by changing training only—that is, by giving special night training in addition to normal day training, while leaving the

[1]See reference 2.
[2]See the second item of correspondence cited in footnote 2, p. 5.
[3]See correspondence cited in footnote 2, p. 5, and references 3, 6, 11, and 21.
[4]See references 3, 11, and 21.
[5]See correspondence cited in footnote 2, p. 5, and reference 6.
[6]See references 6 and 21.
[7]See footnote 2, p. 5.

sights just as they now are. Such a solution would be attended by several other distinct advantages: It would in no way affect the present solution to day requirements, or the ruggedness or weight of the rifle; nor would it affect other night requirements, such as shooting under artificial illuminations of either the steady (searchlight) or pyrotechnic (flare) types.[1] All things considered then, both the Army and its research agencies could agree that the most immediately promising general solution to the night problem lay in investigation and perfection of special techniques of weapon alignment, and development of realistic training methods to bring these new techniques into efficient practical use.

Requirements for an Effective Night Firing Technique for the M1 Rifle with Iron Sights

From review of the most pertinent literature on night detection and night delivery of fire,[2] from on-the-ground study of on-going experimentation in night delivery of fire at Fort Dix and Fort Benning,[3] and from HRU No. 3's studies in night detection (MOONLIGHT I) and pilot studies in night delivery of fire, it was concluded that an effective technique of firing the M1 rifle under very low natural illuminations (quarter moon and less) without special sighting equipment would have to meet the following general requirements.

Requirement 1: During target definition, weapon alignment, and firing, the shooter must keep both eyes open.[4] Under very low illumination the essential component in target definition is brightness-contrast sensitivity—the ability to notice differences in the brightness of relatively large areas, such as between a target and its surrounds.[5] If one eye is kept closed, as normally is done in firing under high illumination, one-half of his brightness-contrast sensitized area is lost to the shooter.[6]

Requirement 2: At all times, and during weapon alignment particularly, both of the shooter's eyes must be sufficiently above any near-by intervening object (such as the rifle) to avoid interference due to the masking of parts of the peripheral retinal areas of the eyes from the extremely feeble incident light rays reflected from target and surrounds. If this precaution is not taken, the target may be lost by the shooter at the critical moment of obtaining an initial alignment.[7]

Requirement 3: The shooter must utilize an accurate and consistent method of obtaining initial alignment of his weapon on the target. Since he

[1]Previous experimentation, by the 9th Infantry Division at Fort Dix, had evolved a night firing technique for simulated pyrotechnic-type situations which effectively utilized the day sighting system (See reference 6.) This particular technique held considerable promise also for use under both high steady artificial illuminations and the brighter natural illuminations, such as full moonlight and dawn and dusk conditions. (See references 6 and 7.)

[2]See references 1, 2, 3, 4, 6, 7, 8, 10, 11, 14, 15, 16, 19, 20, and 21.

[3]The Fort Dix experiments were conducted by the 9th Infantry Division, and those at Fort Benning by The Infantry School.

[4]See reference 11.

[5]See reference 10.

[6]From shooter reports, it is certain that *functionally* loss of target *does occur* under the circumstances described; the ascription of such loss to the reasons adduced probably is no more than a pedagogically convenient, but effective, oversimplification.

[7]See immediately preceding footnote.

cannot see his iron sights under very low illuminations, a variety of "pointing" technique becomes mandatory for laying on the target both in deflection and in range.[1]

Requirement 4: The eyes of the shooter must be protected from the muzzle flash of firing in order to avoid impairment of his dark adaptation.[2] Such a consideration makes the use of a flash hider or suppressor advisable. Without such a device the shooter may be effectively blinded for from 3 to 10 seconds after each round is fired.

Requirement 5: The shooter should have access to an accurate and consistent means of checking initial alignment, so that if this is faulty it may be improved and perfected from round to round of firing.

Summary of Requirements: In summary, these requirements may be briefly stated as follows: (1) the shooter must keep both eyes open, (2) he must keep both eyes high, (3) he must use a pointing technique, (4) he must protect his dark adaptation, and (5) he should check and improve alignment from round to round. Ideally speaking, any effective night firing technique should make feasible the fulfillment of all five of these requirements by means of its conditions and procedures, and any successful training method should be designed to teach efficiently such a given basic technique in the most economical and practical manner possible.

Three Night Firing Techniques

Three different techniques of delivering fire at night were finally decided upon as the basis for the various special training methods to be devised. These were:

(1) A slightly modified version of a technique devised and first used by the 9th Infantry Division at Fort Dix
(2) A technique devised and first used by The Infantry School at Fort Benning
(3) A new "center-fire" technique devised by the MOONLIGHT II research team

Each of these techniques met to a varying degree the full list of requirements outlined, but among them they represented what were thought to be the best probabilities for success in the purely training type of solution to the night firing problem.

(1) The Revised Fort Dix Technique

A description of the original technique is quoted:[3]

Under Higher Illuminations: "Existence of some type of battlefield illumination (moonlight, flare, refracted light from searchlight, dawn, dusk, etc.) which permits visibility of front sight. The firer locates his target with both eyes open. Then with only his shooting eye open, he aims directly over the lowered rear sight and lines up sights in light to side of target. He then moves the sights into and below the target and fires the piece."

[1]See references 21, 7, and 11.
[2]See reference 11.
[3]See reference 7.

Under Lower Illuminations: "Darkness prevailing to the extent that the firer cannot see the front sight. The firer aims as far down the barrel as he can see, and this point then becomes the front sight. The firer then takes Kentucky depression to get on the target. After he feels he is on the target, he allows an additional yard of Kentucky depression. This compensates for having his eye a little above the rear sight."

The only modification made in the technique by the MOONLIGHT II staff consisted in requiring a fully raised rear sight instead of a lowered one. This was an attempt to make the technique fit Requirement 2 better by getting the eye a little farther above the rifle. It should be noted that use of only one eye in alignment and firing of the piece violated Requirement 1, but this requirement was fulfilled in the target definition phase. Use of a flash hider fulfilled Requirement 4, and Requirements 3 and 5 were at least partially met.

(2) The Infantry School Technique

In this technique[1] the firer used an individually determined amount of hold-off which he had previously tested and found successful in day firing without sights at the night mid-range. The hold-off (low and right) was to compensate for the tendency to fire high and left when both eyes are open and the head is held high during weapon alignment and firing. This technique met completely all of the requirements except Requirement 5.

(3) The New Center-Fire Technique

This technique was fabricated "out of whole cloth," so to speak, with the express intention of completely meeting all of the five requirements, which neither of the other two techniques was quite able to do. A detailed description of this technique follows.

(a) Obtaining Correct Deflection. In the prone position the firer loosens his normal hasty sling just enough to accommodate movement of the rifle stock, so that the ridge of the stock bisects the chin. His head is erect and he searches for the target with both eyes open. When his chin rests on the stock, his eyes are sufficiently above the axis of the rifle to search out the target. When the target is located, the firer points his rifle by moving his head, body, and rifle as a rigid whole by wiggling his feet and hips and pivoting on his elbows. He continues to do this until he senses or estimates the target between his eyes and on a line with his nose and barrel. He then squeezes off a round. If the rifle barrel has deviated from the nose-target line in the course of movement of head and body, the firer can check this fact by noting out of the bottom of his eyes (still focused on the target as he fires) the position of the center of the flash relative to the nose-target line. A fine correction in deflection is then made by feel and the firer is ready to shoot again.

(b) Obtaining Correct Range. If his elevation is correct, the firer should hit either the first or second time he fires using this technique. Elevation is obtained by feel. If the firer has a normal position he can sense

[1]See reference 11.

when his rifle is approximately parallel to the ground. If the ground in front of him is flat and deflection is correct he should get hits at just below knee level on the standing M-type target. Adjustment of differences in altitude of gun and target, due to slope of terrain, can be made by moving the left elbow (in the case of a right-handed shooter) either slightly in or out along the gun-target line. Similarly, positions of the shot group can be raised or lowered at will.

(c) Reducing Shock of Recoil. In order to reduce the shock of recoil and to prevent injury to the firer, a tight hasty sling must be maintained with the rifle butt held firmly against the fleshy part of the chest near the chest bone. The rifle rests parallel to the ground. There are both high and low versions of the correct position. For example, in the lowest version of the position the butt may be partially against the ground (toe) and hence only partially against the chest (heel). This results in minimum silhouette, or exposure, of the firer and maximum protection from the recoil of the piece, since the ground can be made to take most of the recoil.

(4) Comparison of the Different Techniques

The advantages and disadvantages of each of the three techniques for delivering fire at night may be summarized as follows:

(a) The Fort Dix technique was suitable for use with all firing positions, but was least effective for meeting the nighttime requirements, especially for the lower illumination.

(b) The Infantry School technique was suitable for use with all firing positions, and met the nighttime requirements well but not perfectly.

(c) The new center-fire technique was suitable only for use in the prone position (or standing, from a foxhole), but met all the nighttime requirements perfectly.

Five Night Training Methods

An effective technique is a set of procedures involving the use of certain skills, a way of doing a job efficiently. A training method, on the other hand, is much more than a technique, although the latter may be the basis of the former. A successful training method encompasses orderly, economical, and practical means of installing and ingraining the know-how essential to its basic technique or techniques. It also must provide means, through proper organization of both its content and conditions, for the motivation and understanding necessary to ensure the timely, unfailing, and proper use of this technique or techniques.

As a result of over-all survey of the many peculiarities inherent in the night firing situation, it was apparent that a successful night training method for any one of the three basic night firing techniques would have to accomplish the same general objectives in about the same order. Broadly stated, these steps were (1) to show the soldier what he cannot do, and why not, (2) to show him how he can, and why, and (3) to let him prove he can, for his own confidence and to clinch the training.

(1) Showing the soldier what he cannot do, and why not

It is natural for the soldier who has received training in day methods of firing to attempt to apply, or transfer, these methods to the night situation. After all, he had previously used them successfully, and to him the night ranges at first appear ridiculously short by contrast to those of day. Therefore, the soldier brings with him to the night situation a kind of built-in cockiness and disdain, and sometimes even worse, a lackadaisical apathy toward instruction, all because he has little realization of the true nature of the task that now confronts him.

It is well to have confidence, but it is a demonstrable fact that the confidence the soldier first brings to the night situation is largely misplaced, and that, unless properly counteracted, it will only lead him to fire over and over again, but with insignificant results. Ineffective rifle fire is doubly damaging at night; not only does it waste ammunition but it always gives away in detail the location of the friendly position. For these reasons, the first step in a method that is to effectively teach night firing must be to convince the soldier that he cannot successfully apply his day skills.

The first part of special night training, called Familiarization Firing, was designed therefore to show the soldier, through his own performance in a free situation, that he cannot succeed appreciably at night by using day methods. This, however, is not sufficient; he must next be shown why he is unable to succeed, and he must be encouraged through promise of further instructions which will enable him to effectively overcome his difficulties.

Familiarization Firing and Demonstration of the Night Firing Error[1] together constitute the first step (also Part I) of training for all three basic techniques.[2] If the soldier is to fire finally according to the Fort Dix technique, he will now be ready for the Fort Dix Lecture and Night Applicatory Firing, both to be given together in a single package.[3] If he is to finally utilize either of the other two techniques, he will proceed to other intervening instruction, which is described in the next section.

(2) Showing the soldier how he can, and why

At the end of the first step (also part) in training, the soldier will have determined, by his own performance and therefore to his own satisfaction, that the seemingly easy task of night shooting is in reality quite difficult, and that it is not to be solved by application of his daytime technique of laying. Further than that, he is now armed with the knowledge of what causes the night firing error. He has learned that detection of targets and weapon alignment at night are problems to be solved by further instruction. He will have begun to think hard, perhaps for the first time, about the night problem; and, if the first part of training has been effectively executed, he should be highly motivated to take the next step.

This second step has a dual purpose: (a) the soldier must be taught that a different system of laying the piece on the target is both feasible

[1]See Appendix B, Part I, for detailed treatment of both.

[2]See Figure 2, under "Experimental Design."

[3]See pages 18 and 19 and Appendix B (Part V and Inclosure 1 to Part V).

and effective, and how he is to utilize it, and (b) he must be shown how to make better use of his eyes (night vision) in picking up and following night targets. Part II of special night firing training, called Daytime Corrective Firing, was designed to accomplish the first purpose of the second step, and Part III, called Night Vision Training, was designed to accomplish the second purpose.[1]

(a) Daytime Corrective Firing. A daytime situation was designed to simulate certain important aspects of nighttime conditions (i.e., inability to use the rifle sights) by use of a training aid—namely, the M1 rifle without sights, either front or rear. The soldier is thus shown, again by his own performance and to his own satisfaction, how here too he can and will make the night firing error, and how he can overcome this error by utilizing a different technique of laying. At the end of this part of training, he has mastered the Infantry School technique of night firing. By use of a gradually learned, individually determined amount of hold-off (low and right for a right-handed shooter) he has gotten consistent hits at the night mid-range of 50 yards; his night battle zero for this particular technique has been obtained.

(b) Night Vision Training. In a blacked-out classroom with proper training aids, the soldier is shown, once again largely by his own performance and to his own satisfaction, how proper dark adaptation, off-center vision, night scanning, and confidence in his own eyes properly used will all aid him in the task of target detection at night.

The soldier is now ready for Night Applicatory Firing (see pages 18-19), if he is to do that firing according to the Infantry School technique. If, however, he is to be taught to fire by the new technique, he is now ready for an additional part of training (Part IV) called Day Training in Night Technique, which must intervene in this case before Night Applicatory Firing (Part V).

(c) Day Training in Night Technique. In this part of training, with proper aids, the soldier is taught the new center-fire technique.[2]

(3) Letting the soldier prove he can, to build true confidence

The third step of training concerns itself with the building of true confidence. The soldier is reintroduced to precisely the same situation that he encountered first in Familiarization Firing, but this time he applies whichever night firing technique he has learned[3] and as a natural consequence he utilizes his night vision training for the first time in a field situation. This training differed somewhat in this experiment, according to the particular night technique taught to the soldier. In the case of soldiers firing according to the Fort Dix technique, it consisted only of whatever the trainee had received under Army Training Programs 21-114 and 7-600-1; but in the case of soldiers firing according to either of the other two techniques, it consisted of Night Vision Training or The Infantry School Problem No. 1282.[4]

[1]For detailed treatment of both of these parts of training, see Appendix B, Parts II and III and Enclosure I to Part III.

[2]See Appendix B, Part IV, for details.

[3]If he is to fire the Fort Dix technique he must receive the Fort Dix lecture just prior to Night Applicatory Firing. (See Appendix B, Part V, Inclosure I.)

[4]See Appendix B, Part III, and reference 13.

Regardless of the technique learned in special night firing training, at the end of Night Applicatory Firing[1] the soldier was prepared to be measured on the Criterion Course.[2]

(4) Experimental Design (Night Training Methods Part)

From the preceding discussion the possibilities for experimental design become clearly apparent. First, there are three basic night firing techniques to be compared. Second, any special training method employs the same three steps, but methods for the different techniques have different parts, under the steps. There could therefore be a minimum of three different methods to be compared (see Figure 2). But addition of two methods, both of

OUTLINE OF MINIMAL EXPERIMENTAL DESIGN

Three Night Training Methods, Each Utilizing a Different Basic Technique

	Method 1 Fort Dix Technique	Method 2 TIS Technique	Method 3 Center-Fire Technique
Training Step 1 *Show the soldier what he cannot do, and why not*	Part I Familiarization Firing (Demonstration of the Night Firing Error)	Part I Familiarization Firing (Demonstration of the Night Firing Error)	Part I Familiarization Firing (Demonstration of the Night Firing Error)
Step 2 *Show the soldier how he can, and why*	(Fort Dix Lecture)	Part II Daytime Corrective Firing Part III Night Vision Training	Part II Daytime Corrective Firing Part III Night Vision Training Part IV Day Training in Night Technique
Step 3 *Let the soldier prove he can*	Part V Night Applicatory Firing	Part V Night Applicatory Firing	Part V Night Applicatory Firing
Test	Firing Criterion Course (Record Firing)	Firing Criterion Course (Record Firing)	Firing Criterion Course (Record Firing)

Figure 2

[1] For details, see Appendix B, Part V.
[2] See earlier section "The Individual Night Proficiency Course" and Appendix A.

necessity built around the center-firing technique, makes possible a five-method design from which the relative individual contributions of all of the principal parts of night training can be assessed. To gain the maximum information from the minimum experimental input, such a design was decided upon (see Figure 3).

OUTLINE OF EXPERIMENTAL DESIGN

Five Night Training Methods, Utilizing Three Basic Techniques

Method A Center-Fire Technique	Method B TIS Technique	Method C Center-Fire Technique	Method D Center-Fire Technique	Method E Fort Dix Technique
Part I Familiarization Firing	Part I Familiarization Firing	Part I Familiarization Firing	Part I Familiarization Firing	Part I Familiarization Firing
Part II Daytime Corrective Firing	Part II Daytime Corrective Firing	Part II Daytime Corrective Firing		
Part III Night Vision Training	Part III Night Vision Training		Part III Night Vision Training	
Part IV Day Training in Night Technique		Part IV Day Training in Night Technique	Part IV Day Training in Night Technique	
Part V Night Applicatory Firing	Part V Night Applicatory Firing	Part V Night Applicatory Firing	Part V Night Applicatory Firing	Part V Night Applicatory Firing *(preceded by Fort Dix lecture)*

Figure 3

The design demands that night firing skills be equated for all groups by matching the groups that take different methods on the basis of scores obtained from Familiarization Firing, which they all received together under the same conditions. It was desirable also to match the groups on certain other possibly pertinent background variables, such as night vision ability, day vision ability, and intelligence (as reflected in Aptitude Area I scores). All of this was accordingly done (see Table 1).

Table 1

MATCHING OF EXPERIMENTAL SUBGROUPS ON BACKGROUND VARIABLES

Groups	Background Variables									
	Night Firing Ability		Night Vision Ability				Day Vision Ability		Aptitude Area I	
			Starlight		Moonlight					
	Mean	SD[a]	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A	6.10	3.21	17.35	8.48	69.00	25.00	65.06	7.83	93.50	21.14
B	6.20	2.99	20.60	13.64	77.70	31.50	55.20	18.80	90.83	15.02
C	5.85	3.02	14.63	9.07	82.00	34.70	55.95	15.50	92.53	14.69
D	6.25	2.93	18.65	8.70	80.32	25.58	60.53	12.60	89.65	18.64
E	6.20	3.71	19.00	7.37	83.57	19.90	63.14	8.04	87.93	19.55

Results of Analyses of Variance

	Variance Ratio (F)	Significance Level[b] (p)
Night Vision Ability		
Starlight	0.92	Not Sig.
Moonlight	0.65	Not Sig.
Day Vision Ability	1.70	Not Sig.
Aptitude Area I	0.24	Not Sig.

[a]SD: Standard deviation.

[b]Throughout this report, a value was not considered statistically significant unless it was at the .05 level or better.

Testing the Results of Both Standard (Day) and Special (Night) Training

The Control Group

Standard training consisted of pertinent instruction as given under Army Training Programs 21-114 and 7-600-1.[1] One hundred infantry soldiers in the control group received standard (day) training only. This subgroup completed ATP 7-600-1 at Camp Rucker, Ala.,[2] just prior to firing the Criterion Course Test. One hundred other infantry soldiers, also in the control group, had received standard training plus battle experience in night firing of small arms in Korea.[3] They fired the Criterion Course at the same times

[1]Both since revised. OCAFF ATP 21-114 was revised on 24 September 1953, and OCAFF ATP 7-600 (Revised) superseded ATP 7-600-1 on 12 September 1953. Other minor changes have been made since these dates.

[2]These were men of Company M, 135th Infantry Regiment, 47th Infantry Division. They completed 16 weeks of basic training on 8 July 1953.

[3]About one-half of these men were Korean combat veteran returnees from the 8th Infantry Division, Fort Jackson, S.C., the other half were men of The Infantry School Detachment, Fort Benning. To meet the criterion for selection, they had to have fired small arms on the main line of resistance or on night patrol in Korea.

and under the same conditions of illumination as did the 100 who received standard training only. Both subgroups were matched on background variables. Thus it could be ascertained whether the factor of actual battle experience made any difference in night firing proficiency. The performance of the control group provided a solid basis for gauging the degree of improvement that would accrue from special (experimental) night training.

The Experimental Group

The various kinds of special training given here have already been described.[1] The experimental group of subjects consisted of 100 infantry soldiers, half of whom had previously received standard training only,[2] and half of whom had had battle experience in addition to standard training.[3] This group was broken down into five subgroups of 20 men each. Each subgroup received, just prior to test, a different kind of special (night) training (see Figure 3). Each subgroup was equally composed of men with and without battle experience. Since each subgroup was comparable to the control group on background variables, comparison of its performance with that of the controls would reveal the degree of improvement attributable to the particular kind of special training involved.

Differing Conditions Within the Control Group

The control group of 200 men was additionally split into four subgroups of 50 men each—25 with and 25 without battle experience. The purpose of the split was to obtain information on the effect on night firing proficiency of the use of certain firing aids—a flash hider and a white string[4] —that had been proposed as beneficial in the night situation.[5] It was necessary to know just how helpful these aids were, for their use in conjunction with the special training methods to be tested later was strictly feasible. The different subgroups were characterized, then, by whether they fired (1) with flash hider only, (2) without either flash hider or white string, (3) with both flash hider and white string, or (4) with white string only.

Firing the Criterion Course (Test)

All groups and subgroups, both experimental and control, fired the Criterion Course under strictly comparable illuminations. Each infantry soldier tested on this course fired, under each illumination tested, a total of 192 rounds or less[6] of cartridge-ball ammunition. Starting at the first firing

[1]See also Appendix B, Parts I through V.

[2]These were men of Company D, 136th Infantry Regiment, 47th Infantry Division. They completed 16 weeks of basic training at Camp Rucker, Ala., on 3 August 1953.

[3]These men were Korean combat veteran returnees from The Infantry School Detachment, Fort Benning. To meet the criterion for selection, they had to have fired small arms on the MLR or on night patrol in Korea.

[4]A wax-coated white string—Braided Cord, Cotton B460, Stock Number 7100-26200—stretched from the front sight to the rear sight.

[5]See reference 11.

[6]The soldier was not required to fire if he could not detect the target, as the interest was in accuracy fire alone. This also conserved ammunition. If he did not fire at a given target, the soldier was given a score of zero hits for that target.

place on the experimental night firing range (see Figure 1), the soldier fired 24 rounds at each M-type silhouette in turn. Starting again at the first firing place, he fired eight rounds at each E-type silhouette.[1] Of the 24 rounds fired at each M-target, eight were fired at the target stationary, eight at the target moving from left to right, and eight at the target moving from right to left. In the case of all stationary targets, both dark and flashing, slow fire was employed; in the case of moving dark targets sustained fire was employed, with a 15-second time limit to get off the clip. Individual scores therefore possible for dark-type targets could range from 0 to 144 hits, and for flashing targets from 0 to 48 hits. For further details of firing the Criterion Course, see Appendix A.

[1]E-type (flashing) targets were not fired at under the higher moonlight levels of illumination.

Chapter 3

GENERAL SUMMARY OF FINDINGS

The findings described in this section were obtained by testing comparable groups of infantrymen on the individual night proficiency course (experimental night firing range) at Fort Benning, 13 July--22 August 1953. The groups were matched in ability upon certain background variables but had received differing treatments, either as to firing conditions on test, or as to degrees and/or kinds of previous training.

Two measurements were used as indices of proficiency for comparing each group with any other group. These measures consisted of the mean total score in hits obtained (1) by firing at dark-type targets, which simulate maneuvering enemy infantry, and (2) by firing at flashing-type targets, which simulate enemy base of fire infantry.

TESTS OF TROOPS WITH STANDARD (CONTROL) TRAINING

16-Week Trained Troops Versus Combat Veterans

(1) Dark Target Firing. In testing trainees who had just finished 16-week basic training and Korean combat veterans on dark targets, no difference in night firing proficiency was found between the groups.

(2) Flashing Target Firing. Testing of 16-week trainees and Korean combat veterans on flasning targets revealed a difference between the groups that was statistically real,[1] but so small as to be of little or no practical significance. This difference was in favor of the veterans.

With and Without Flash Hider

In testing troops equipped with a flash hider (the T-37) and troops not so equipped, no differences were found between the groups in night firing proficiency.

[1]Significant at the .02 level; i.e., a probability of two chances in 100, or less, that such difference could have been the result of chance.

Flash Hider and White String Versus White String Only

In testing troops equipped with both the T-37 flash hider and a white string (stretched from the front to the rear sight) and troops equipped with the white string only, no differences were found between the groups in night firing proficiency.

Flash Hider and White String Versus Flash Hider Only

Comparison of the scores of troops equipped with both flash hider and white string against scores of troops equipped with the flash hider only revealed no differences in night firing proficiency that could be attributed to addition of the white string.

With and Without White String

Comparison of the scores of troops equipped with white string with those of troops who were not so equipped revealed no differences in night firing proficiency that could be attributed to use of the white string.

Effect of Changes in Illumination

(1) Dark Target Firing. Generally, when dark targets were fired upon, raising the illumination level resulted in raising test scores. The continuum of illuminations tested may be divided into at least three perceptually easy-to-discriminate stages, however. These stages may be described, from lowest to highest respectively, as starless, starlight, and moonlight. Mean scores representing different levels within a given stage do not differ from each other in a statistically significant amount in regard to their effect upon night firing proficiency. The mean scores from one stage to another do, however, show differences that are statistically real (probability of .05 or less). This fortunate fact reduces the practical problem of treating varying levels of illumination differently (as in setting passing scores for a record course for night firing classes that will, because of the exigencies of scheduling, fire under different illumination levels) to consideration of at most three cases. Or, if small real differences are to be disregarded, only two cases need be considered—moonless conditions and moonlight conditions.

(2) Flashing Target Firing. Within the limits of this study, when flashing targets were fired upon, raising the illumination level did not result in raising test scores. Changes in illumination level can be disregarded in setting a passing score for flashing targets on a record course.

Effect of Changes in Range

(1) Dark Target Firing. Within the limits of this study (25 to 75 yards) increasing the range to dark targets generally caused a steady decrease in scores under all levels of illumination tested.

(2) Flashing Target Firing. Range, within the limits of this study (85 to 135 yards), has no effect upon the rifleman's ability to hit flashing-type targets under the levels of illumination tested.

TESTS OF TROOPS WITH SPECIAL (EXPERIMENTAL) TRAINING

Comparison of Five Special Methods of Instruction with the Standard Method

Each of five groups of infantrymen, matched initially on night firing ability as well as on other background variables (see Table 1), was given training by a different experimental method (see Figure 3). The methods utilized varied in content, hours, and rounds per trainee.

Three of these methods (A, C, and D) involved firing with the rifle butt held at the center of the trainee's chest, whereas the other two (B and E) involved firing with the rifle butt at the shoulder, as it normally is in daytime firing. (See Table 2.) After training was completed, each experimental group was tested on the individual night proficiency course (see Figure 1). Two indices of proficiency, one for each type of target, were obtained for

Table 2

DESCRIPTION OF SIX DIFFERENT TRAINING METHODS

Method	Night Content	Hours	Rounds per Trainee	Fired From
A	Familiarization Firing	3	16	Chest
	Daytime Corrective Firing	3	30	
	Night Vision Training	2	–	
	Day Training in Night Technique	3	–	
	Night Applicatory Firing	3	16	
	Total	14	62	
B	Familiarization Firing	3	16	Shoulder
	Daytime Corrective Firing	3	30	
	Night Vision Training	2	–	
	Night Applicatory Firing	3	16	
	Total	11	62	
C	Familiarization Firing	3	16	Chest
	Daytime Corrective Firing	3	30	
	Day Training in Night Technique	3	–	
	Night Applicatory Firing	3	16	
	Total	12	62	
D	Familiarization Firing	3	16	Chest
	Night Vision Training	2	–	
	Day Training in Night Technique	3	–	
	Night Applicatory Firing	3	16	
	Total	11	32	
E	Familiarization Firing	3	16	Shoulder
	Fort Dix Lecture	1/2	–	
	Night Applicatory Firing	3	16	
	Total	6 1/2	32	
Control	None	None	None	Shoulder

comparison with those of another group which had received only standard (control) training. The results of comparing the proficiencies of the various experimental groups with that of the control group for each of the three illumination stages (in dark target firing) or over-all (in flashing target firing) are set forth in Table 3.

Table 3

COMPARISON OF RESULTS FROM SIX DIFFERENT TRAINING METHODS[a]

Method	Dark Targets			Flashing Targets (%)
	Illumination			
	Starless (%)	Starlight (%)	Moonlight (%)	
A	NT[b]	20	−22	108
B	80	63	−6	212
C	NT	−5	NT	12
D	NT	−20	NT	−4
E	37	17	−8	−15
Control	0	0	0	0

[a]Expressed as per cent of improvement over a comparable control. E−C/C = % improvement.
[b]NT: Not tested.

(1) A Successful Special Training Method. It was found that one of the experimental methods (Method B) showed substantial improvement over a comparable control for both indices of night firing proficiency.

(2) Limitation of the Successful Method. In the successful method, however, the advantage in dark target firing proficiency of experimental group over control group is lost when illumination is raised as high as moonlight levels. The members of the control group were utilizing ordinary day techniques of rifle marksmanship (learned from standard training) applied to the night situation. Such techniques clearly become relatively less effective as illumination diminishes,[1] as can be seen from inspection of the scores of the control group.[2] It is evident, then, that the moonlight zone of illumination marks, on the one hand, the lower limit for the use of day techniques; and, just as surely on the other hand, the same zone marks the upper limit of usefulness for special night techniques. With moonlight illumination each kind of technique appears to work equally well; with respect to dark-target firing proficiency, there is no clearcut difference between day and night methods.

(3) The "Best" Night Training Method. Because of its demonstrated superiority to all the other methods tested, Method B is recommended. This method consisted of 3 hours of familiarization firing at night to show the soldier how hard it really is to hit targets at night, 3 hours of corrective firing by daylight with M1 rifles minus sights to show and ingrain the proper

[1]See reference 21.
[2]See Table C-7.

correction for night conditions, 2 hours of night vision instruction to explain how to pick up and not lose track of targets at night, and 3 hours of applicatory firing to convince the soldier that with what he has learned he can be effective at night. In essence, it is a question of showing the soldier what he cannot do, why he cannot do it, and how he can do it, then letting him prove he can, to restore his confidence and clinch the training.

(4) Use of the Flash Hider. In all of the experimental night methods tested the flash hider was used. The findings for the flash hider test in the control group show that no difference in proficiency accrues through use of the flash hider (as measured by total scores), and there is absolutely no reason to question the finding as regards slow fire against either dark or flashing targets. Because of the comments of many of the men tested, however, the research staff believes that on moving dark targets lack of a flash hider may slow down the rate of fire appreciably while the firer's eyes adjust.

Effect of Changes in Illumination and in Range

In testing troops with experimental training the same general effects were found as in testing troops with standard training (see page 25).

Chapter 4

DISCUSSION OF SOME BROAD IMPLICATIONS OF THE STUDY

THE CENTRAL IMPORTANCE OF CRITERION BUILDING IN TRAINING RESEARCH

The key to any successful research study in the area of training is of necessity the criterion used to assess the effectiveness of the methods developed. The criterion at once provides for the measurement of the methods and sets their objectives. Because of its dual role, the criterion will always largely determine the course, outcome, and value of the study.

Very rarely, in the case of practically oriented studies such as MOONLIGHT, will a ready-made criterion be found that is at all acceptable. The natural consequence is to force the experimenter to build his criterion instrument. In this, he accepts a responsibility that must not be lightly undertaken. The very least that can accrue from the use of a poorly constructed criterion will be one or the other of two dangers: either (1) failure to discriminate good from bad methods may be the result or (2) methods may be discriminated, but upon an improper basis. The first of these considerations indicates the necessity for the criterion to be an adequate measuring instrument; the second demands that this instrument actually measure what it is intended to measure.

The objection will be raised at this point that, in the case of military studies at least, the criterion is pre-set—that it is and must be always combat. In a sense the objection is valid. Combat effectiveness is and must always be the aim and end product of good military training. The combat situation, however, is not the most desirable place to measure the efficiency of training methods.

There are many reasons why the combat situation fails to be a useful criterion situation in the respect of ability to discriminate the true relative efficacy of methods. It will suffice to marshall but two of these reasons.

First, combat provides a scale with only two points: it is either pass or fail, "go" or "no go" in combat. In this regard, combat provides a criterion that is too simple. Methods that are in reality miles apart in efficiency may very well wind up on the same side of the fence—either on the pass or on the fail side. There can be no positive assurance that the good will always be discriminated from the bad. Secondly, in another respect, combat provides a criterion that is too complex. Because of the vagaries of combat, the determinination of why a given method did or did not work is nearly impossible, or at best is open to the gravest implications of error. A given method that is

under consideration remains but a small part of a large complex, most of which is relatively uncontrolled. Factors such as variations in terrain, weather, enemy action and reaction, fear, and fatigue all enter to hopelessly becloud the issue. Except in broad outline, the fog of war swallows up both cause and effect.

So much, no doubt, will be readily granted by most: that the combat situation maximizes the two dangers inherent in a poorly constructed criterion. By introducing control, on the other hand, of such factors as terrain, weather, enemy action and reaction, fear, and fatigue, the problem of constructing an accurate and reliable instrument for properly discriminating the proficiencies derived from different methods can be greatly reduced—but what of the problem of the validity of this constructed instrument?

Suppose we have done a creditable job of analyzing the possibilities of the combat situation in regard to use of the skills for which we are training. Suppose that incorporation of these possibilities into our training criterion has adhered to the principles of relevance, comprehensiveness, and a true relative emphasis of the component parts. Suppose that we have organized the whole content so that we have in the end a reliable and discriminatory scale of sufficient extent. Can it then be said with confidence that we have a valid criterion? The answer is yes and no.

It is yes, if one means by the question that validity is primarily concerned with a true determination of level of skill and hence of efficacy of method per se. It is no, if by the question is meant that validity is primarily concerned with the sure ascertainment of success in battle proportional to demonstrated level of proficiency on the criterion. In short, one must freely accept the limitation that a high score on a properly constructed criterion does not automatically ensure the same degree of success in that aspect of combat for which training is given. Granted the equality of other things, though, this same high score can be expected to be the best prediction of success.

Acceptance of this limitation imposed upon all criteria designed to measure skill as relatively uncontaminated by other nonetheless important variables is a necessary safeguard to straight thinking; it is granted that it may also constitute a motivational hazard for the experimenter. The former aspect of this acceptance of limitation will ensure that the experimenter does not fall into the trap of assuming that skill under his conditions of measurement is necessarily coordinate to skill assayed under dissimilar conditions. The latter aspect of acceptance of limitation can happen only if honest admission by the experimenter that his criterion is less than a one-to-one predictor of battle success should cause him to lose interest, relatively speaking, in the perfection of this most important part of his research.

Bestowal of the key role upon criterion building in training research not only helps to assure the accurate discrimination of real differences in competing training methods but also greatly facilitates the derivation of effective methods in the first place, since these will inevitably be suggested by ways seen to increase proficiency upon the constructed instrument. In this manner the criterion will serve economically to focalize effort in devising methods. On the other hand, the full value of such a shift in emphasis to the criterion must be protected by acceptance of greater responsibility—the responsibility to be absolutely correct in the selection and organization of all components that will enter into the structure.

From the foregoing argument it should be concluded that it is mandatory (1) to emphasize the role of the criterion to the degree of its acceptance as the major determinant of the course, outcome, and value of any given experiment in training, and (2) in accordance with this shift in emphasis to build the criterion, never accepting less than the optimum that may be achieved within reasonable bounds of time and money expenditures.

Such at least was one of the principal general hypotheses that governed the approach to the problem studied in MOONLIGHT II; it is thought that the results of the study strengthen the hypothesis.

Some may object that criterion building is too expensive to be made the general practice, however desirable—that it is much more economical to continue the commoner practice of accepting ready-made criteria. Here the relatively small cost of a properly constructed criterion must be weighed against the relatively large expense of a complete experimental failure. In the long run, which will cost the taxpayer less? It is forthwith submitted that the cost of military training research prohibits gambling with success.

THE IMPORTANCE OF SELF-DEMONSTRATION IN TRAINING METHOD

The other principal general hypothesis germane to the approach taken in MOONLIGHT II was that the trainee learns best by doing. In our interpretation, this meant that each important point of instruction should be demonstrated by the trainee to himself by means of his own performance in the action situation. In such way it was hoped to achieve the motivational climate so necessary to rapid learning.

The first correlative hypothesis held that verbal instruction or explanation should never be used until the trainee had first provided himself, through his own performance and hence to his complete satisfaction, with firm experiential referents for the ideas that would be verbally presented. By this order of events it was thought that understanding would be more swiftly and dependably fostered.

Generally the conditions of both the principal hypothesis and its correlate were scrupulously adhered to (this was especially true in the case of the most successful method, Method B). It is believed that the results of MOONLIGHT II serve to strengthen both the hypothesis and the correlate.

In the present Army instructional system, particularly as this pertains to the training divisions, emphasis upon mass-production methods in training has created problems of both instructor and trainee motivation. The chronic dearth of really qualified instructors and the necessary concessions to economy, in administrative organization of instruction and in trainee handling generally, have aggravated these problems. The natural consequence is a relatively strong demand for improvement in instructional methods per se. To succeed in this milieu, methods must meet the general criteria—to show the soldier what he cannot do and why not, to show him how he can and why, and to let him prove he can—as a minimum requirement. Further, it is believed that such requirement can better be met by adopting the working hypotheses advanced in this section as firm conclusions and proceeding accordingly with them as the principal guidelines for the development of future methods.

Ideally, in short, methods should be so constituted that the instructor is depended upon only in the capacity of a caretaker of the situational aspects of the conditions and procedures under which and according to which learning will take place, the principal dependence being placed in the efficiency of the method itself to induce this learning of the task by the trainee. For such to be the case it is mandatory that the sequence of the conditions and procedures be so ordered that proper motivation is self-generated by the trainee and proper understanding is assured to him and at the same time made easy for him.

It takes no seer to realize that, under the pressures attendant upon a total mobilization, the advantages of methods so constituted (relatively independent as they are of instructor skills) will be at a high premium; now—not then—is the best time to devise, test, and perfect such methods of instruction for all of the essential combat skills, against the time when their possession and use may very well be crucial.

BIBLIOGRAPHY
AND
APPENDICES

SELECTED BIBLIOGRAPHY

1. Chapanis, A. "Night Vision—a Review of General Principles." *The Air Surgeon's Bulletin*, Vol. 2, 1945, pp. 279-284.
2. *Combat Training of the Individual Soldier and Patrolling, Field Manual 21-75*, Department of the Army, Washington 25, D.C., 20 October 1950.
3. Humphries, D. and Livengood, G.C. "Let's Fight at Night," *The Infantry School Quarterly*, January 1953.
4. Johnson, E.P., *et al. Report of the Working Group on Night Vision Training of the Armed Forces-NRC Vision Committee*, 15 June 1951.
5. Kelly, H. E. "The Future of Night Attack." *Military Review*, October 1942.
6. Letter AHOGC, from Office of the Assistant Chief of Staff, G-3, Headquarters 9th Infantry Division, Fort Dix, N.J., to Col. Robert L. Cook, G-3 Section, Office of the Chief of Army Field Forces, Fort Monroe, Va., dated 6 January 1953, Subject "Night Firing M-1 Rifle," with Inclosures 1, 2, and 3.
7. Letter AHOGC 353, from Headquarters 9th Infantry Division, Fort Dix, N.J., to Chief of Army Field Forces, Fort Monroe, Va., Attn: G-3 (Colonel Corley), dated 3 July 1953, Subject "Data on Night Firing Exercises," with Inclosures Tabs "A" through "G".
8. Neel, S.H. Jr. "Night Vision in Ground Combat," *U.S. Army Combat Forces Journal*, June 1952.
9. Newsletter. Army Field Forces, Fort Monroe, Va., 1 May 1953.
10. *New Tests of Night Vision* (PRB Bulletin 53-1), Personnel Research Branch, Personnel Research and Procedures Division, The Adjutant General's Office, Department of the Army, January 1953.
11. *Night Firing of the M-1 Rifle.* Draft of Report of a Board, Weapons Department, The Infantry School, Fort Benning, Ga., covering experimentation during the period 3 November-17 December 1952.
12. *Night Firing of M-1 Rifle Without Artificial Illumination. Training Circular No. 27*, Department of the Army, Washington 25, D.C., 22 December 1953.
13. *Night Vision. Instructor Set, Problem No. 1282*, The Infantry School, Fort Benning, Ga.
14. Rostenberg, L.O. "Night Vision Studies," Department of Gunnery, The Field Artillery School, Fort Sill, Okla., 17 February 1944.
15. Sharp, L.H., Gordon, D., and Reuder, M. "Review of Studies on the Effects of Training on Night Vision Ability" (PRS Report 974), Personnel Research Section, The Adjutant General's Office, Department of the Army, 27 August 1952.

16. Shore, S. F. "Night Firing," *U.S. Army Combat Forces Journal*, September 1951.

17. *Targets, Target Material, and Training Course Lay-Outs. Technical Manual 9-855*, Department of the Army, Washington 25, D.C., 2 November 1951.

18. *The War With Japan: Parts 1, 2, and 3.* Department of Military Art and Engineering, U.S. Military Academy, West Point, N.Y., 1950.

19. Uhlaner, J.E. "Validation of the Army Night Vision Tester" (PRS Report 816), Personnel Research Section, The Adjutant General's Office, Department of the Army, 30 January 1950.

20. Verplanck, W.S. "Report of the Working Group on Night Vision Training," Minutes and Proceedings of the Armed Forces-NRC Vision Committee, 29th Meeting, 16-17 November 1951, pp. 49 ff.

21. Warden, C.J. "Visual Factors in Sighting at Dim Levels of Illumination: I. Laboratory Studies," *Journal of General Psychology*, Vol. 42, 1950, pp. 349-372.

Appendix A

THE CRITERION
(TEST)

CONTENTS

THE INDIVIDUAL NIGHT PROFICIENCY COURSE (EXPERIMENTAL NIGHT FIRING RANGE)

SUBJECT: Test: Firing the Criterion Course (Record Firing).

PURPOSE: To measure the proficiency of the individual infantry soldier firing the M-1 rifle under low illuminations.

TIME: During hours of darkness.

PLACE: Experimental night firing range.

UNIFORM: Fatigue cap, fatigue jacket and pants, cartridge belt and filled canteen, field shoes.

WEAPON: M-1 rifle w/flash hider.

AMMUNITION: Maximum of 192 rounds of caliber .30, cartridge ball, per man per illumination (4 illuminations), maximum total of 768 rounds per man.[1]

TRAINING AIDS:
- 1 Standing pasteboard target M (M 1913), painted flat black and modified for mounting on target car, per each firing place per each 6 men per each illumination.
- 1 Kneeling pasteboard target E (M 1917), painted flat black and modified for simulation of small arms fire, per each firing place per each 12 men per each illumination.
- 1 Rifle target B, painted flat black and mounted on two stakes, per each firing place.[2]
- Supply of black patches per each firing place.
- 1 GI flashlight w/red lens per each firing place.
- 1 Clipboard per firing place.
- 1 Set of scoresheets per man per illumination.

OTHER EQUIPMENT:
- 1 Sound system w/portable generator.
- 1 Ambulance.

EXTRA PERSONNEL:
- 1 Control Officer.
- 1 Safety Officer per firing place.
- 1 Target Scorer per firing place.
- 1 Hand Winch Operator per firing place.
- 1 Ammunition Supply NCO.
- 1 Sound Man.
- 1 Medical Corpsman.

PROCEDURE: Under at least 4 illuminations (dark starlight, bright starlight, pale moonlight, and bright moonlight)[3] the infantry soldier will

[1]Men did not fire unless they could detect the target in each case.

[2]To be placed immediately in back of each E-target (at a distance of 5 yards) to ensure that only the flash and not the outline is seen.

[3]The term dark starlight describes a rather narrow range of natural illuminations characterized by no moon and with cloud cover in varying degree; bright starlight refers to a wider range of natural illuminations characterized also by no moon, but with no cloud cover (i.e., with stars shining brightly but with varying degree of atmospheric haze). Pale moonlight represents an even wider range of natural illuminations of one quarter of the moon's surface or less with clear skies, or a greater moon with varying degree of cloud cover. Bright moonlight refers to clear skies with greater moon than one quarter surface (up to brightest full moon), and constitutes the widest range of natural illuminations of all four. The four ranges of illuminations are perceptually quite distinctly discrete.

fire for record at two (2) types of targets: 1. M-type silhouettes (stationary and moving) for simulation of maneuvering infantry; and 2. E-type silhouettes (stationary only) for simulation of infantry delivering small arms fire.
From the prone position the soldier will fire the following course under each illumination tested:

(1) 1 clip of 8 rounds at a stationary M-type target at each of the following ranges in respective order: 25, 35, 45, 55, 65, and 75 yards.[1]

(2) 1 clip of 8 rounds at an M-type target moving left to right, in respective order at each range specified in (1) above.[2]

(3) 1 clip of 8 rounds at an M-type target moving right to left, in respective order at each range specified in (1) above.[2]

(4) 1 clip of 8 rounds at E-type targets flashing six times rapidly every ten seconds (to simulate burp gun fire) at each of the following ranges in respective order: 85, 95, 105, 115,125, and 135 yards.[1]

The soldier will receive a score in number of hits per target in (1), (2), (3), and (4) above.

INSTRUCTIONS: "Tonight you are going to fire a course of six targets ranging from 25 to 75 yards. You will begin firing on Lane 1 at the 25 yard target. When it is your turn to fire you will be directed to Lane 1. You will report to a firing coach who will direct you all the time you are on the course. As soon as your coach reports you are ready you will hear the command to 'Lock and Load' and then the command 'Commence Firing'. You will fire a clip of eight rounds at a 25 yard stationary target. When you have finished firing and the line is clear you will hear the command 'Scorers Forward'. The scorer for your lane will go out on the course, replace your target, return with your target, and score it. When the line is clear you will again lock and load and commence firing on command. This time your target will move slowly from left to right. You will be given fifteen seconds to fire your eight rounds. You will be given the command to 'Cease Fire' after fifteen seconds and you will stop on this command even if you have not fired your full clip. After the scorers have cleared the line you will be commanded to fire at a target moving from right to left. You will again stop firing on command at the end of fifteen seconds. This will complete your firing on Lane 1 and you, your coach, and your scorer will move to Lane 2 and fire in the same way at a 35 yard target. When you get to each lane your coach will ask you if you can see the target. If you cannot see the target you will not continue to fire as we are interested only in your ability to hit targets you can see."

[1]Each target engaged by slow fire.
[2]Each target engaged by sustained fire, 15-second limit.

TASK MOONLIGHT: Proficiency Firing Record Sheet [1]

Subject's Name ______________________________ Code No.[2] ____________

Date ______________________ Start Time ________ End Time ____________

Illumination ________________ Scorer's Name ____________________

	Targets	Hits		Targets	Hits
1)	S-25	________	13)	S-65	________
2)	L-R-25	________	14)	L-R-65	________
3)	R-L-25	________	15)	R-L-65	________
4)	S-35	________	16)	S-75	________
5)	L-R-35	________	17)	L-R-75	________
6)	R-L-35	________	18)	R-L-75	________
7)	S-45	________	19)	F-85	________
8)	L-R-45	________	20)	F-95	________
9)	R-L-45	________	21)	F-105	________
10)	S-55	________	22)	F-115	________
11)	L-R-55	________	23)	F-125	________
12)	R-L-55	________	24)	F-135	________

[1]Kept by the Target Scorer and verified by the Firing Coach (Safety Officer).

[2]Each man had an assigned *code number.* This number described the group and/or subgroup to which the man belonged. For example, Code Nos. 001 through 200 characterized the control group, whereas Code Nos. 201 through 300 characterized the experimental group, etc.

TASK MOONLIGHT: Firing Method Record Sheet[1]

Subject's Name ______________________ Code No.[2] __________

Date ______________ Start Time _____ End Time __________

Illumination __________ Coach's Name ______________________

Position: a. Normal (for daylight firing) ______________________

b. Variation (explain) ______________________________

____

Sighting: a. During detection:

1. Both eyes open ______ one eye open ______.

2. Head high ______ head low ______.

b. During alignment:

1. Both eyes open ______ one eye open ______.

2. Head high ______ head low ______.

3. Head up and down ______.

c. During firing:

1. Both eyes open ______ one eye open ______.

2. Head high ______ head low ______.

Sling: a. Tight hasty sling: ______________________________

b. Variation (explain): ______________________________

____

Remarks: ____

____

[1]Kept by the Firing Coach (Safety Officer).

[2]Each man had an assigned *code number*. This number described the group and/or subgroup to which the man belonged. For example, Code Nos. 001 through 200 characterized the control group, whereas Code Nos. 201 through 300 characterized the experimental group, etc.

TASK MOONLIGHT: Illumination Record Sheet[1]

	Date	Time	Place	Photometer Number	Photometer Operator	Photometer Reading	Reading in Foot Candles
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

[1]Illumination was recorded, by use of a radium-spot photometer, at approximate half-hour intervals, as the normal rule. If conditions, however, were undergoing rapid change, then more frequent readings were taken. All readings were made off of standard white photographic blotting paper. The square of paper was always mounted on a stake about 5 feet above ground level and located in the center of the firing line facing in the same direction as the targets on the range. Such numerical photometer readings were then translated into foot candles of illumination by use of a conversion table derived from calibration data taken on a particular operator working with a particular instrument. The calibration of operators and their instruments was carried out 15-18 April 1953, at the Department of Electrical Engineering, Tulane University, New Orleans, La. The instruments were furnished by courtesy of the U.S. Army Engineering Research Laboratory, Fort Belvoir, Va., from stocks on hand with that institution's Tulane University subcontractor.

Appendix B

SPECIAL TRAINING
(EXPERIMENTAL TRAINING)

CONTENTS

PART I

SUBJECT: Familiarization Firing (& Demonstration of the Night Firing Error).

PURPOSE: To insure that the infantry soldier recognizes the true nature of the problem involved in effective night shooting.

TIME: During hours of darkness.[1]

PLACE: Any known distance range. (The hundred yard firing line will be utilized, and the targets will be set out in the flat between the firing line and the butts. Every other firing place will be used on the line.)

UNIFORM: Fatigue cap, fatigue jacket and pants, cartridge belt and filled canteen, field shoes.

WEAPON: M-1 rifle w/o flash hider.

AMMUNITION: 16 rounds of caliber .30, cartridge ball, per man (1 illumination—starlight).

TRAINING AIDS: 1 Standing pasteboard target M (M 1913), painted flat black, per each firing place per each 6 men.
Supply of black patches per each firing place.
1 GI flashlight w/red lens per each 3 firing places.
1 Axe (for driving target stakes).
1 Fort Dix Night Firing Error Demonstrator.

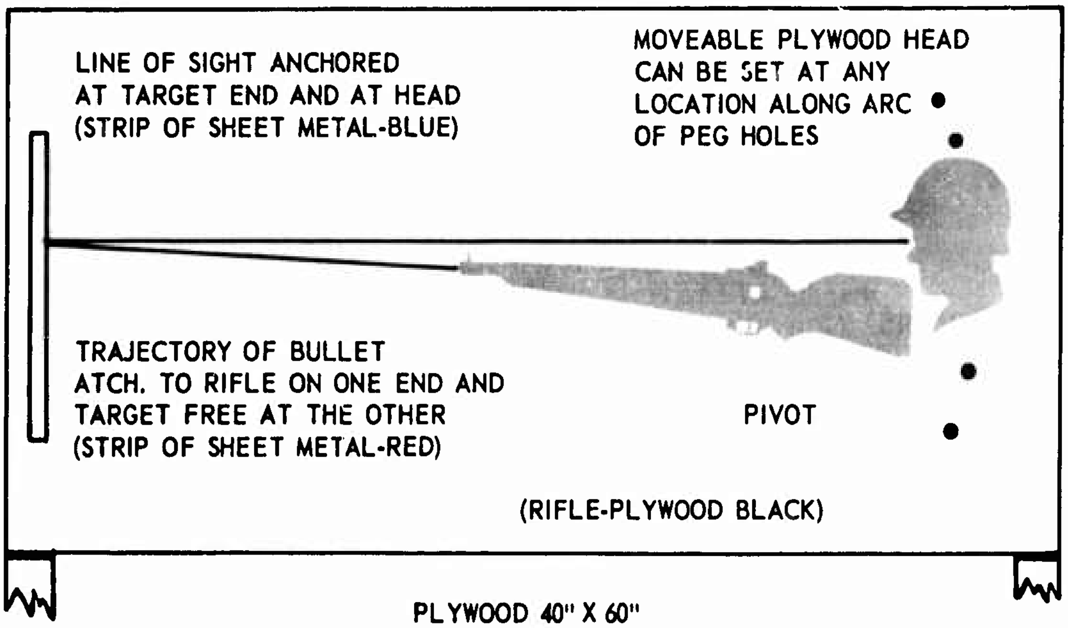
OTHER EQUIPMENT: 1 Sound system w/portable generator.
1 Ambulance.

EXTRA PERSONNEL: 1 Control Officer.
3 Assistant Control Officers.
1 Safety Officer per each 3 firing places on the line.
1 Target Scorer per each 3 firing places on the line.
1 Sound Man.
1 Medical Corpsman.

PROCEDURE: After 30 minutes of dark adaptation the infantry soldier fires 2 clips of 8 rounds each (a total of 16 rounds), 1 clip at each of two targets, one target at short range and one target at midrange. Both targets are stationary M-type silhouettes. The short range target is at 25 yards; the midrange target is at 50 yards. The soldier fires on the short range target first. He is free to use any method of alignment which he likes and thinks will be effective, but he is restricted to the prone position. He is cautioned that a good position and a good trigger squeeze are just as important in effective night shooting as they are in effective day shooting. The soldier is given knowledge of results after each clip of 8 rounds is fired. One Target Scorer per each 3 firing places on the line is utilized to help the soldier with his ammunition and to score the target. One Safety Officer per each 3 firing places on the line is utilized

[1] Three hours for 100 men, in the experiment.

NORMAL SIGHT PICTURE AND TRAJECTORY



PLYWOOD 40" X 60"

EXAGGERATED SIGHT PICTURE AND TRAJECTORY

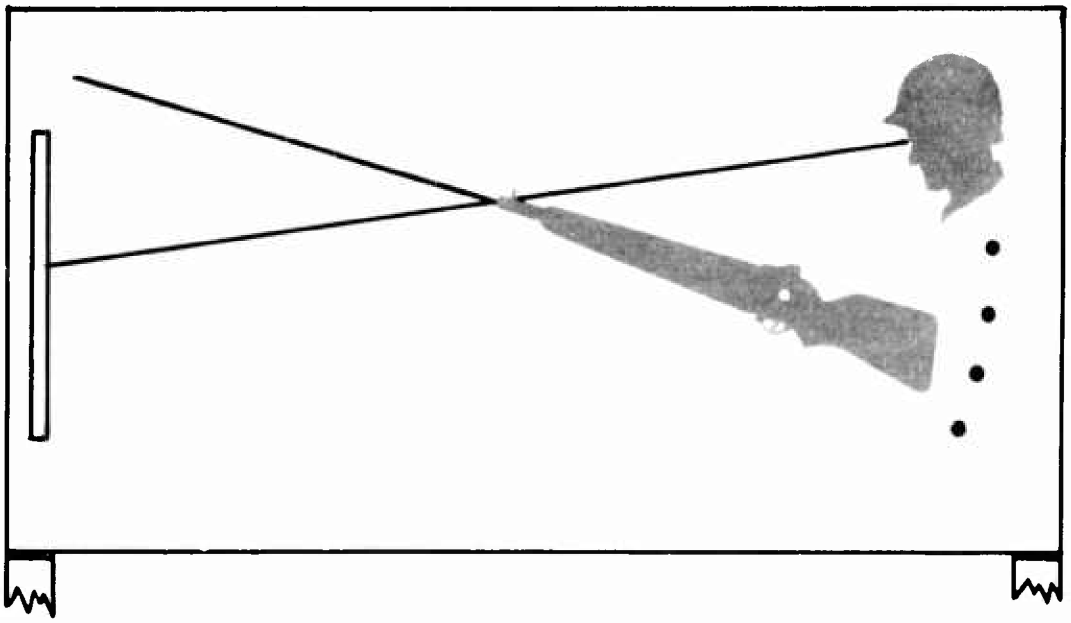


Figure 2.–A training aid demonstrates that to fire accurately at night, the firer must keep his head raised and both eyes open.

SOURCE: Training Circular No. 27, Department of the Army, December 1953.

to insure safety and to make certain behavioral observations. After all firing is completed, the soldier is encouraged to verbalize the difficulties he encountered in shooting under these conditions. Finally, the soldier is shown the Fort Dix Night Firing Error Demonstrator (see Figure 2 in TC 27, reproduced on page 45), has explained to him the principal reasons for his difficulties, and is told that he will receive training the next day that will enable him to overcome the difficulties in shooting effectively at night. He is told that the next night he will fire the same course again to apply the skills that he will have learned.

INSTRUCTIONS: (For use with the Night Firing Error Demonstrator, see page 45.) "If you will direct your attention to the training aid here I will explain why you shoot high at night. This object (pointing) represents a soldier's head and the blue line represents his line of sight. The black silhouette represents a rifle. Notice the red line which extends from the muzzle of the rifle which represents the trajectory or path of the bullet; at the end of the board is the target. At present you can see the soldier's line of sight extends along the sights of the rifle and the bullet trajectory roughly parallels the line of aim and terminates in the target, but what happens when the firer cannot see his sights? Notice that as I raise the rifleman's head, his line of aim no longer passes through either sight. The rifle hasn't moved and if fired it would still hit the target, but it is natural to want to have the enemy in your sights, so the rifleman raises the front end of the barrel so that the muzzle of the rifle is lined on the target. As a consequence, what happens to the bullet? You can see it goes over the target."[1]

[1]Adapted from Lecture for Night Firing, Tab B, letter AHOGC 353, from Hq, 9th Infantry Division, Fort Dix, N.J. to Chief, Army Field Forces, Fort Monroe, Va., Attn: G-3 (Col. Corley), dated 3 July 1953, Subject: "Data on Night Firing Exercises." (See Inclosure I, Part V.)

PART II

SUBJECT: Daytime Corrective Firing.

PURPOSE: (a) In daylight to simulate certain important nighttime conditions to such degree that the infantry soldier is convinced by demonstration of his own performance that shooters generally fire high and left at night;

(b) To teach the soldier how to correct for the nighttime tendency to fire high and left.

TIME: During daylight hours.[1]

PLACE: Any known distance range. (A firing line 50 yards from the butts will be utilized, and the targets will be pulled and scored from the butts as normal.)

UNIFORM: Fatigue cap, fatigue jacket and pants, cartridge belt and filled canteen, field shoes.

WEAPON: M-1 rifle w/o sights, front or rear.

AMMUNITION: Approximately 30 rounds of caliber .30, cartridge tracer, per man.

TRAINING AIDS: 1 Rifle target B per each place on the firing line.
Supply of both black and white spotters per each target.
Supply of both black and white patches per each target.

OTHER EQUIPMENT: None.

EXTRA PERSONNEL: 1 Control Officer.
4 Assistant Control Officers (Safety Officers).
1 Firing Coach (Student) per each man on the line.
1 Target Operator (Student) per each man on the line.

PROCEDURE: The infantry soldier is given a weapon with no sights, front or rear. He is instructed to hold at six o'clock on the bull, and to take his sight picture and fire with both eyes open. From the prone position he then fires a 3-round shot group at a B-type target from 50 yards range (the night midrange). When spotted, he will see that his shot group was high and left. At this point the soldier is reminded of his difficulties of the night before. The principal reasons for his difficulties are again pointed out; how the situation he is presently in has been built to simulate certain important nighttime conditions with their attendant difficulties is explained to him; and he is instructed to compensate for the tendency to fire high and left by holding low and right. The soldier then continues to fire 3-round shot groups at the target until he has got one complete shot group inside the bull ring. After his first shot group, the soldier is assisted in adjusting his fire upon the target by a Student Firing Coach who lies directly behind him and observes the strike of his tracer for each round. From this point on, corrections are made from round to round, on the advice of the coach, until the shooter has learned how much low and right that he must hold to compensate for erroneous tendencies present at night and demonstrated in the present situation. After the soldier has got his complete shot group in the bull ring, he is taken off the firing line and admonished to remember his "correction", which, being obtained at the night midrange, becomes his night battle zero.

[1]Three hours for 60 men, in the experiment.

PART III

SUBJECT: Night Vision Training.

PURPOSE: In the classroom to teach the infantry soldier the known principles of seeing effectively at night.

TIME: During daylight hours.[1]

PLACE: Blacked out classroom.

UNIFORM: As prescribed.

WEAPON: None.

AMMUNITION: None.

TRAINING AIDS: As prescribed for The Infantry School Problem No. 1282.

OTHER EQUIPMENT: 1 Radium spot photometer for setting level of shadowgraph screens.
1 Check list per man (see Inclosure 1 to PART III, attached).

EXTRA PERSONNEL: 1 Officer Instructor.
2 Enlisted Assistant Instructors.

PROCEDURE: The infantry soldier is given a two-hour night vision class. (Refer to The Infantry School Problem No. 1282.) The only modifications for this class will be (1) to set the level of illumination on the shadowgraph screens at a known proper amount by measurement with the radium spot photometer, and (2) to furnish each man with a check list upon which he will indicate the targets that he actually identifies.

[1]Two hours for 60 men, in the experiment.

Inclosure 1 to Part III.

NIGHT VISION QUESTIONNAIRE

NAME ______________________________________ CODE NUMBER __________

You have now completed your classroom work in night vision. At this time place a check mark beside each object that you saw and identified. on the shadowgraph screen. Don't guess. Mark only the objects that you actually recognized.

_____ FLAGPOLE
_____ TANK
_____ ARTILLERY PIECE
_____ BRIDGE
_____ JEEP
_____ FACTORY
_____ TWO SOLDIERS
_____ AIRPLANE
_____ I SAW SHADOWS ON THE SCREEN, BUT DID NOT RECOGNIZE ANYTHING.
_____ I DID NOT SEE THE SHADOWGRAPH SCREEN

PART IV

SUBJECT: Day Training in Night Technique.

PURPOSE: To teach the infantry soldier an effective technique of delivering fire on a target under low illuminations when there are no precise reference points for holding low and right (as he learned to do in PART II).

TIME: During daylight hours.[1]

PLACE: Any large shed-type building.

UNIFORM: Fatigue cap, fatigue jacket and pants, cartridge belt and filled canteen, field shoes.

WEAPON: M-1 rifle.

AMMUNITION: None.

TRAINING AIDS: 6 Rifle targets B, with bull rings cut out of the targets, mounted on stands w/rollers.

OTHER EQUIPMENT: 6 large tables and 6 chairs.

EXTRA PERSONNEL: 1 Officer Instructor.
6 Officer Demonstrators.

PROCEDURE: The infantry soldier will have explained to him the established requirements for an effective technique of firing the M-1 rifle at night. The previous experience of the soldier, derived from the training that he has received so far, will be sufficient by this stage to make him understand the true nature of the requirements, and he will believe that they must be met successfully. He will be told that, although he has learned previously to correct his erroneous nighttime tendencies by holding low and right (in Corrective Firing) he will not be able to pick out convenient reference points under the lowest illuminations for exercise of the skill of hold-off. Because this is so, he must be taught a newly devised technique that will solve this problem as well as fulfill completely all requirements. At this point the New Technique[2] will be thoroughly explained to the soldier. Following the explanation, the technique will be demonstrated by 6 well-trained Demonstrators who will assume its position on the 6 tables. The soldier will walk around the tables examining the position in detail. Then the student group will be broken down into coach-pupil pairs. The pupil will assume the position on the table. Seated in a chair behind a B-frame 20 yards away, and looking through the cut-out bull ring, the coach will criticize and correct flaws in the pupil's technique by bringing the pupil accurately on the coach's head in alignment. The coach will move the target to the right and to the left, practicing the pupil in changing alignment successfully. Coach and pupil will then swap off and repeat the procedure outlined above. The exercise will continue until both have mastered the New Technique.

[1] Three hours for 60 men, in the experiment.

[2] See pages 15-16, body of this report.

PART V

SUBJECT: Night Applicatory Firing.

PURPOSE: To give the infantry soldier opportunity to apply what he has learned so far; to build the soldier's confidence in his ability to deliver effective fire under low illuminations.

TIME: During hours of darkness.[1]

PLACE: Any known distance range. (The hundred yard firing line will be utilized, and the target will be set out in the flat between the firing line and the butts. Every other firing place will be used on the line.)

UNIFORM: Fatigue cap, fatigue jacket and pants, cartridge belt and filled canteen, field shoes.

WEAPON: M-1 rifle w/flash hider.

AMMUNITION: 16 rounds of caliber .30, cartridge ball, per man (1 illumination—starlight).

TRAINING AIDS: 1 Standing pasteboard target M (M 1913), painted flat black, per each firing place per each 6 men.
Supply of black patches per each firing place.
1 GI flashlight w/red lens per each 3 firing places.
1 Axe (for driving target stakes).

OTHER EQUIPMENT: 1 Sound system w/portable generator.
1 Ambulance.

EXTRA PERSONNEL: 1 Control Officer.
3 Assistant Control Officers.
1 Safety Officer per each 3 firing places on the line.
1 Target Scorer per each 3 firing places on the line.
1 Sound Man.
1 Medical Corpsman.

PROCEDURE: The procedure is exactly the same as in Familiarization Firing except that the infantry soldier utilizes the experimental technique of night firing that he has learned,[2] and he fires a weapon equipped with a flash hider. After firing is over, a conference will be held and the soldier will be encouraged to express his reaction to the experimental training program.

[1]Three hours for 100 men, in the experiment.

[2]Either the Fort Dix Technique, or the Infantry School Technique, or the New Technique. If the Fort Dix Technique, he is given the Fort Dix *Lecture for Night Firing* before Night Applicatory Firing. See Inclosure 1 to PART V, attached.

Inclosure 1 to Part V.

(MODIFIED) FORT DIX LECTURE FOR NIGHT FIRING

Good evening men, I am _________. Tonight I am going to teach you how to fire at night under two types of night firing conditions. The first of these conditions is when there is some type of illumination which will allow your front sight to silhouette. Things that will allow this condition to exist are a moonlight night, a flare, the light just before dawn or after dusk in the evening. The other condition in which I am going to teach you to shoot is when it is so dark that you can't see the front sight but you can see the rear sight and part way down the top of your rifle. If I can teach you to hit a target at night under these two conditions, I know you can stop an enemy who has been forced to fight at night because of the superiority of our fire power. Before I go deeper into these two methods of night firing I want to bring you up to date on the development of night firing. At the beginning of the Korean War when our lines were stretched almost to the breaking point, the North Korean soldiers would crawl up to within a few yards of our lines and throw hand grenades into our positions. The American soldiers would shoot at them and then estimate that they killed any number of the enemy. The next morning there would hardly be any enemy dead to back up their claim. It didn't take our commanders long to determine that the reason that there were no dead enemy was due to the fact that we were missing the enemy at night. Night firing tests were held by using a back drop to record the misses of rounds fired at a silhouette target and it was found almost all men were shooting from three to five feet over the target. As a result of these tests we have developed an improved method of night firing.

I will now show you some test targets fired by trainees who received no instruction on how to shoot at night. Notice that they fired high over the targets.

I want each of you to raise your rear sight as far up as it will go. Now if you used the top of the rear sight to aim you would not hit the same place on a target as you would by using your peep sight when it is set for battle sights. The reason for this is that your eye is in a higher location looking over the top of your rear sight when it is up than it is when looking through the peep sight. It is understood that you can not aim through your peep sight at night because it is designed to shut out light.

It is understood that if there is enough light to silhouette your target, there will be enough light to silhouette your front sight. It is also understood that your target will appear black at night. Now your front sight and rear sight also appear black and you can not see black on black, but there is light to the sides or around the target. Therefore you line up your sights to the sides of the target being careful to have your eye sighting just over the top of the peep sight, then you move the rifle into the target. As you move the rifle into the target the sight disappears, but you can see the wings on the front sight guard which still silhouettes the sides of the target. If an equal portion of these wings are visible on both sides of the target, you are sure that you are centered on the target and from this point on it is correct trigger squeeze that will enable you to hit the target.

Now let us take up the other night firing condition when light conditions are so poor (darkness, rain, fog, etc.) that you are unable to see the front sight of your rifle. When this condition arises, you have to pick a point along the top of the barrel that you can see, that is as close to the front as possible, use this farthest visible point as a front sight, and align it with the target and rear sight. Remember, the farther back on the barrel you sight, the higher your shot group will be, therefore, the lower you will have to aim on, or in

front of, your target. When firing using this method, and you feel you are "on the target," allow one yard more of Kentucky depression at the target, this allows for you having your eyes a little above the rear sight.

Something else we must consider is that if our sights are misaligned just one half inch horizontally or vertically, at seventy-five yards the strike of the bullet will be four feet off the center of the target. It is not important to remember the figures—but remember that minute errors in sight alignment are magnified to gross error at ranges which we might be firing.

In the method that I want you to use to insure that your eye is in the correct position just above the rear sight, lower your head until the rear sight blocks your vision and raise your head just enough to see the top of the front sight blade (i.e. farthest point on top of your rifle), lay on a low point on your target, take up the slack and squeeze off the round. This method of aiming is applicable on all types of flat trajectory weapons such as the carbine, BAR, machine gun, and the automatic rifle.

Are there any questions? (Ask a few questions to insure that instruction has been absorbed.)

Appendix C

DETAILED STATISTICAL SUMMARY

Results of Tests on the Experimental Night Firing Range

Fort Benning, Ga., 13 July – 22 August 1953

CONTENTS

INTRODUCTION

The statistical null hypothesis assumes that observed differences between the mean of comparable groups are the results of sampling only (viz., pure chance). In order to reject this hypothesis, and hence to accept such differences as real, it is necessary to set some very low probability figure in favor of chance.

In this study the level of confidence elected for rejection of the null hypothesis was the .05 level. That is to say, the null hypothesis was rejected (and a real difference between the means of the groups was assumed) whenever the statistical ratio utilized indicated a probability of five times or less per hundred that the difference between group means could be attributable to chance alone. In each such case found, throughout these data, the actual probability (p) or significance is always specified (e.g., is accompanied by a statement such as "Significant at probability of .05," or .02, or .01, or .001, and so on as the case may be). On the other hand, however, the null hypothesis was retained whenever the probability in favor of chance amounted to over five per hundred. In the latter cases no actual probability is cited in these data; the statistical ratio involved is merely accompanied by the statement "Not significant," or "Not Sig." In these data, analysis of variance always preceded a test between group means; such tests were not made in any case unless the variance ratio (F) was significant. Generally, Student's t was the statistical ratio employed as the test between means, but when the assumptions could not be met (e.g., because of inhomogeneity of the variances) resort was taken to the median test (a non-parametric test) instead.

TESTS OF TROOPS WITH STANDARD (CONTROL) TRAINING

16-Week Trained Troops Versus Combat Veterans

(1) Dark Target Firing. See Table C-1. The results of the various analyses of variance for night vision scores, day vision scores, and Aptitude Area I (intelligence) scores show that the groups were no different on these background variables. The percentage of Negroid personnel was roughly equivalent for both groups, and was reasonably close to the proportion existing in the Army as a whole. For both starlight and moonlight illumination the variance ratios (F's) for dark target scores are not significant (at the .05 level of confidence).

(2) Flashing Target Firing. See Table C-1. The variance ratio (F) for flashing target scores was 5.91 with degrees of freedom (df's) of 1 and 196. This indicates that the difference between the means of the groups is statistically real, at the .02 level. The difference was so small, however (0.94 of a hit), that it has little or no practical significance.

With and Without Flash Hider

See Table C-2. The groups were equivalent in night vision ability, day vision ability, and intelligence. The percentage of Negroid personnel was exactly the same for each group, and each group fired under comparable

illumination. None of the variance ratios (F's) for the firing scores was significant at the .05 level of confidence.

Flash Hider and White String Versus White String Only

See Table C-3. Since the groups were equivalent on background variables, and the variance ratios (F's) of firing scores were all insignificant (at the .05 level), there was no difference in performance between the groups.

Flash Hider and White String Versus Flash Hider Only

See Table C-4. The difference between the means on starlight dark target scores approaches significance. Such difference is attributable to a small discrepancy between the illuminations fired under (mean illumination of .000065 foot candle, for flash hider and white string, versus mean illumination of .000094 foot candle, for flash hider only).

With and Without White String

See Table C-5. The difference between the means on starlight dark target scores approaches significance. Such difference is attributable to a small discrepancy between the illuminations fired under (mean illumination of .000052 foot candle, with white string, versus mean illumination of .000088 foot candle, without white string).

Effect of Changes in Illumination

(1) Dark Target Firing. Table C-6 compares the effect on night firing proficiency (dark target scores) for seven different levels of illumination. These are, in respective order from lowest to highest:

Starless_1	No moon, completely overcast
Starless_2	No moon, partially overcast
Starlight_1	Stars only, great atmospheric haze
Starlight_2	Stars only, little or no atmospheric haze
Moonlight_1	Either one quarter or less of the moon's surface with clear skies, or greater moon through overcast
Moonlight_2	One quarter to one half of the moon's surface, varying degree of atmospheric haze
Moonlight_3	Over one-half of the moon's surface, varying degree of atmospheric haze

The result of analysis of variance for the dark target scores for these groups was an F of 8.05, with df's of 6 and 389, which is significant at probability of .001. The results of the t tests, however, indicate that there are no real differences between the two starless groups, between the two starlight groups, or between the three moonlight groups.

Table C-7 shows the results of combining the seven levels of illumination into three stages of illumination: starless, starlight, and moonlight. They differ significantly from one to another in their effect on dark target scores. The conclusion that variations of illumination level within a stage have no effect on dark target scores (see page 25) receives further substantiation in that the Pearson product moment correlation between shooting scores and

illumination readings for starlight produced an r of -.09 (for N of 135 pairs of observations), which is not significant at the .05 level. This was the only such correlation possible to obtain, since the light readings at the extremes of illumination tested fell outside the range of calibration data for the photometers (i.e., under .000032 foot candle for the lower extreme of starless, and over .007 foot candle for the upper extreme of moonlight) and hence remained undiscriminated at these limits.

(2) Flashing Target Firing. Tables C-8 and C-9 clearly show that change in illumination has no effect on flashing target scores. Both tables present the same data, but in different ways. In Table C-9, for example, the various mean illuminations for individuals have been sorted out and combined for certain specific ranges of illumination (i.e., the four rather heterogeneous levels of Table C-8 are combined into the three homogeneous stages of Table C-9.

Effect of Changes in Range

(1) Dark Target Firing. Tables C-10 and C-11 show the effect upon dark target scores of increasing range (from 25 to 75 yards) respectively for moonless and for moonlight conditions. Any line of either table adequately reflects the trend, which is the same under both zones of illumination—a steady decrement in scores as range increases. Nowhere is there a reversal of this trend.

(2) Flashing Target Firing. Table C-12 shows clearly the lack of effect upon flashing target scores of increasing range (from 85 to 135 yards) for over-all illumination. Examination of any line of the table will indicate that no one range favors mean hits more than any other.

TESTS OF TROOPS WITH SPECIAL (EXPERIMENTAL) TRAINING

Comparison of Five Special (Experimental) Methods of Instruction with the Standard (Control) Method

Considered as wholes, the experimental and control groups were practically no different on the background variables of night vision ability, day vision ability, intelligence, and race (although, statistically, the whole control was a little better on day vision ability than was the whole experimental—mean score of 64.01 to mean score of 59.18, F of 6.79 with df's of 1 and 282, significant at probability of .01). Broken down into subgroups, however, even the latter disparity disappears, and in each case of comparison to be made, the control and experimental subgroups involved are no different on the various background variables. Additionally, all experimental subgroups were precisely matched on night firing ability (see Table 1).

(1) A Successful Special Training Method. Inspection of Tables 3, C-13, C-14, C-15, and C-16 will clearly reveal that one of the special (experimental) methods, Method B, was superior to all other methods tested, both control and experimental, with but two minor exceptions. These exceptions are (1) that B, like all other experimental methods, was no better than the control on dark target under moonlight, and (2) that B was no better (statistically) on flashing targets than was Special Method A, although both of these were far better than the comparable control.

(2) Limitation of the Successful Method. It already has been pointed out (in the preceding paragraph) that no experimental method was statistically any different from the control under the moonlight zone of illuminations.

Effect of Changes in Illumination and in Range

See Table C-17. The general effects of changes in illumination and in range were the same for experimentally trained troops as they had been for regularly trained troops (see pages 25 and 57-58, and Table C-6 through C-12). In Table C-17, comparison of figures within a column for the first three lines will reveal the effect of change in illumination for a given range (dark target firing); and inspection of any one of the first three lines will reveal the effect of changes in range for a given illumination (dark target firing). The fourth line of Table C-17 gives the whole picture for flashing target firing. All figures cited in this table refer to performance of the group trained according to Method B, the most successful special method.

A NOTE ON THE RELIABILITY OF CRITERION SCORES

Because of strict time limitations, there was but one opportunity to fulfill the requirements for replication of performance under similar illumination. Compare Subgroups A and A', Table C-14. Because N was so small (less than 20 pairs of observations) a correlation coefficient would not be very meaningful, but it can be observed that the subgroup mean is very stable, viz. 31.05 to 31.18. Further treatment of this topic is reserved for a Staff Memorandum to appear later.

Table C-1

CONTROL GROUP: COMPARISON OF PERFORMANCE BETWEEN 16-WEEK TRAINED TROOPS AND COMBAT VETERANS

Matching on Background Variables

No. of Subjects	Kind and/or Degree of Training	Night Vision Ability		Day Vision Ability		Aptitude Area I		% Negroid
		Mean	SD[a]	Mean	SD	Mean	SD	
100	Basic	73.0	28.7	64.0	14.6	91.0	16.8	20
100	Basic & Combat	76.9	31.8	64.1	14.2	87.5	18.4	15

Results of Dark Target Firing

No. of Subjects	Kind and/or Degree of Training	Mean Total Hits			
		Starlight		Moonlight	
		Mean	SD	Mean	SD
100	Basic	23.10	12.20	64.42	22.43
100	Basic & Combat	23.43	11.00	60.28	22.31

Results of Flashing Target Firing

No. of Subjects	Kind and/or Degree of Training	Mean Total Hits	
		Mean	SD
100	Basic	2.22	2.43
98	Basic & Combat	3.16	3.04

Results of Analyses of Variance[a]

	Variance Ratio (F)	Significance Level[b] (p)
Night Vision Ability	0.80	Not Sig.
Day Vision Ability	0.00	Not Sig.
Aptitude Area I	2.04	Not Sig.
Dark Target Firing		
Starlight	0.07	Not Sig.
Moonlight	2.21	Not Sig.
Flashing Target Firing	5.91	.02

[a]SD: Standard deviation.

[b]Throughout this report, a value was not considered statistically significant unless it was at the .05 level or better.

Table C-2

CONTROL GROUP: COMPARISON OF PERFORMANCE BETWEEN TROOPS FIRING WITH AND WITHOUT THE T-37 FLASH HIDER

Matching on Background Variables

No. of Subjects	Firing Conditions	Night Vision Ability		Day Vision Ability		Aptitude Area I		% Negroid
		Mean	SD	Mean	SD	Mean	SD	
50	W/Flash hider	69.2	29.4	62.1	16.6	88.6	17.7	18
50	W/O Flash hider	78.9	31.4	63.7	14.3	89.0	17.8	18

Results of Dark Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits			
		Starlight		Moonlight	
		Mean	SD	Mean	SD
50	W/Flash hider	25.70	12.00	66.58	19.05
50	W/O Flash hider	25.10	9.93	62.33	19.96

Results of Flashing Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits	
		Mean	SD
50	W/Flash hider	2.50	2.95
50	W/O Flash hider	2.38	2.03

Results of Analyses of Variance*

	Variance Ratio (*F*)	Significance Level (*p*)
Night Vision Ability	0.97	Not Sig.
Day Vision Ability	0.48	Not Sig.
Aptitude Area I	0.05	Not Sig.
Dark Target Firing		
Starlight	2.53	Not Sig.
Moonlight	1.05	Not Sig.
Flashing Target Firing	0.95	Not Sig.

*All analyses also include the two subgroups of C-3, for a total of four subgroups.

Table C-3

CONTROL GROUP: COMPARISON OF PERFORMANCE BETWEEN TROOPS FIRING WITH FLASH HIDER AND WHITE STRING AND TROOPS FIRING WITH WHITE STRING ONLY

Matching on Background Variables

No. of Subjects	Firing Conditions	Night Vision Ability		Day Vision Ability		Aptitude Area I		% Negroid
		Mean	SD[a]	Mean	SD	Mean	SD	
50	W/FH & WS	77.3	28.8	64.9	14.0	89.7	17.7	22
50	W/WS Only	74.1	30.4	65.4	12.2	89.7	17.8	12

Results of Dark Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits			
		Starlight		Moonlight	
		Mean	SD	Mean	SD
50	W/FH & WS	20.32	13.40	59.52	29.07
50	W/WS Only	21.74	9.83	60.92	19.94

Results of Flashing Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits	
		Mean	SD
48	W/FH & WS	2.60	2.57
50	W/WS Only	3.22	3.34

Results of Analyses of Variance[a]

	Variance Ratio (*F*)	Significance Level (*p*)
Night Vision Ability	0.97	Not Sig.
Day Vision Ability	0.48	Not Sig.
Aptitude Area I	0.05	Not Sig.
Dark Target Firing		
Starlight	2.53	Not Sig.
Moonlight	1.05	Not Sig.
Flashing Target Firing	0.95	Not Sig.

[a]All analyses also include the two subgroups of C-2, for a total of four subgroups.

Table C-4

CONTROL GROUP: COMPARISON OF PERFORMANCE BETWEEN TROOPS FIRING WITH FLASH HIDER AND WHITE STRING AND TROOPS FIRING WITH FLASH HIDER ONLY

Matching on Background Variables

No. of Subjects	Firing Conditions	Night Vision Ability		Day Vision Ability		Aptitude Area I		% Negroid
		Mean	SD	Mean	SD	Mean	SD	
50	W/FH & WS	77.3	28.8	64.9	14.0	89.7	17.7	22
50	W/FH Only	69.2	29.4	62.1	16.6	88.6	17.7	18

Results of Dark Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits			
		Starlight		Moonlight	
		Mean	SD	Mean	SD
50	W/FH & WS	20.32	13.40	59.52	29.07
50	W/FH Only	25.70	12.00	66.58	19.05

Results of Flashing Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits	
		Mean	SD
48	W/FH & WS	2.60	2.57
50	W/FH Only	2.50	2.95

Results of Analyses of Variance[a]

	Variance Ratio (*F*)	Significance Level (*p*)
Night Vision Ability	0.97	Not Sig.
Day Vision Ability	0.48	Not Sig.
Aptitude Area I	0.05	Not Sig.
Dark Target Firing		
Starlight	2.53	Not Sig.
Moonlight	1.05	Not Sig.
Flashing Target Firing	0.95	Not Sig.

[a]All analyses include all four subgroups undergoing different firing conditions.

Table C-5

CONTROL GROUP: COMPARISON OF PERFORMANCE BETWEEN TROOPS FIRING WITH AND WITHOUT WHITE STRING

Matching on Background Variables

No. of Subjects	Firing Conditions	Night Vision Ability		Day Vision Ability		Aptitude Area I		% Negroid
		Mean	SD	Mean	SD	Mean	SD	
50	W/String	74.1	30.4	65.4	12.2	89.7	17.8	12
50	W/O String	78.9	31.4	63.7	14.3	89.0	17.8	18

Results of Dark Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits			
		Starlight		Moonlight	
		Mean	SD	Mean	SD
50	W/String	21.74	9.83	60.92	19.94
50	W/O String	25.10	9.93	62.33	19.96

Results of Flashing Target Firing

No. of Subjects	Firing Conditions	Mean Total Hits	
		Mean	SD
50	W/String	3.22	3.34
50	W/O String	2.38	2.03

Results of Analyses of Variance[a]

	Variance Ratio (*F*)	Significance Level (*p*)
Night Vision Ability	0.97	Not Sig.
Day Vision Ability	0.48	Not Sig.
Aptitude Area I	0.05	Not Sig.
Dark Target Firing		
Starlight	2.53	Not Sig.
Moonlight	1.05	Not Sig.
Flashing Target Firing	0.95	Not Sig.

[a]All analyses include all four subgroups undergoing different firing conditions.

Table C-6

CONTROL GROUP: EFFECT OF RAISING ILLUMINATION LEVEL UPON DARK TARGET SCORES, SEVEN DIFFERENT LEVELS OF ILLUMINATION

Name	Illumination[a]			Dark Target Scores			N[b]
	Range	Median	Mean	Median	Mean	SD	
Starless$_1$	Up to 32	32–	?	16.0	15.90	8.91	31
Starless$_2$	33– 48	41	39	19.5	19.71	9.27	34
Starlight$_1$	49– 78	63	65	23.0	25.62	12.19	56
Starlight$_2$	79– 254	96	109	23.0	25.89	11.45	79
Moonlight$_1$	255–2000	1610	1542	54.0	55.42	21.64	26
Moonlight$_2$	2001–7000	3970	4259	64.5	64.22	22.01	60
Moonlight$_3$	Over 7000	7000+	?	61.5	63.04	21.97	110

Results of Analyses of Variance

	Variance Ratio (F)	Significance Level (p)
Starless and Starlight	8.05	.001
Moonlight	1.54	Not Sig.

Starless and Starlight Matrix (from t tests)

	Ss$_1$	Ss$_2$	St$_1$	Ss$_1$
Ss$_1$		Not Sig.	.01	.01
Ss$_2$			.02	.01
St$_1$				Not Sig.

[a]Illumination expressed in millionths of a foot candle.
[b]Number of subjects.

Table C-7

CONTROL GROUP: EFFECT OF RAISING ILLUMINATION UPON DARK TARGET SCORES, COMBINATION OF SEVEN DIFFERENT LEVELS INTO THREE DIFFERENT STAGES

Name	Illumination[a]			Dark Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
Starless	Up to 48	32	?	17	17.89	9.29	65
Starlight	49– 254	84	90	23	25.78	11.76	135
Moonlight	255 on Up	7000+	?	61	62.39	22.11	196

Results of Analysis of Variance

	Variance Ratio (*F*)	Significance Level (*p*)
Starless, Starlight and Moonlight	252.9	Highly Sig.

Starless, Starlight, and Moonlight Matrix (from *t* tests)

	Ss	St	Mt
Ss		.009	.001
St			.001

Starless, Starlight, and Moonlight Matrix (from median tests)

	Ss	St	Mt
Ss		.001	.001
St			.001

[a]Illumination expressed in millionths of a foot candle.

Table C-8

CONTROL GROUP: EFFECT OF RAISING ILLUMINATION LEVEL UPON FLASHING TARGET SCORES, FOUR DIFFERENT LEVELS OF ILLUMINATION

Name	Illumination[a]			Flashing Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
$Level_1$	Up to 57	32	36	2	2.50	2.95	50
$Level_2$	Up to 290	35	85	2	3.22	3.34	50
$Level_3$	Up to 260	63	84	2	2.38	2.03	50
$Level_4$	Up to 500	80	143	2	2.60	2.57	48

Analysis of Variance, All Levels, Variance Ratio $(F) = 0.95$ (Not Sig.)

[a]Illumination expressed in millionths of a foot candle.

Table C-9

CONTROL GROUP: EFFECT OF RAISING ILLUMINATION UPON FLASHING TARGET SCORES, COMBINATION OF FOUR DIFFERENT LEVELS INTO THREE DIFFERENT STAGES

Name	Illumination[a]			Flashing Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
$Stage_1$	Up to 32	32–	?	2	2.85	3.17	59
$Stage_2$	33– 99	57	59	2	2.43	2.27	97
$Stage_3$	100–500	190	228	2	2.85	3.40	42

Analysis of Variance, All Stages, Variance Ratio $(F) = 0.56$ (Not Sig.)

[a]Illumination expressed in millionths of a foot candle.

Table C-10

CONTROL GROUP: EFFECT OF INCREASING RANGE UPON DARK TARGET SCORES, MOONLESS ILLUMINATIONS

Groups and Subgroups	Mean Dark Target Scores — Range in Yards					
	25	35	45	55	65	75
Whole control	11.13	7.55	3.28	1.03	0.15	0.05
16-week trainees	10.94	7.64	3.38	0.93	0.10	0.01
Combat veterans	11.33	7.47	3.19	1.14	0.21	0.09
With flash hider	11.96	7.94	4.52	1.06	0.20	0.02
Without flash hider	12.20	7.96	3.48	1.08	0.20	0.18
With F. H. & string	9.12	6.78	2.98	1.36	0.08	0.00
With string only	11.26	7.54	2.16	0.64	0.14	0.00

Table C-11

CONTROL GROUP: EFFECT OF INCREASING RANGE UPON DARK TARGET SCORES, MOONLIGHT ILLUMINATIONS

Groups and Subgroups	Mean Dark Target Scores					
	Range in Yards					
	25	35	45	55	65	75
Whole control	17.40	13.40	10.52	8.80	6.52	5.64
16-week trainees	17.52	13.67	11.13	9.01	6.90	6.19
Combat veterans	17.28	13.14	10.01	8.60	6.15	5.09
With flash hider	17.88	14.48	11.16	9.64	7.22	6.20
Without flash hider	18.08	13.00	9.28	8.49	6.73	6.73
With F. H. & string	16.17	12.52	10.75	8.65	6.50	4.94
With string only	17.44	13.60	11.12	8.43	5.64	4.70

Table C-12

CONTROL GROUP: EFFECT OF INCREASING RANGE UPON FLASHING TARGET SCORES, ALL ILLUMINATIONS

Groups and Subgroups	Mean Flashing Target Scores					
	Range in Yards					
	85	95	105	115	125	135
Whole control	0.38	0.45	0.48	0.52	0.47	0.34
16-week trainees	0.25	0.41	0.39	0.49	0.39	0.28
Combat veterans	0.61	0.50	0.57	0.55	0.56	0.40
With flash hider	0.48	0.40	0.34	0.53	0.52	0.38
Without flash hider	0.38	0.38	0.43	0.58	0.46	0.16
With F. H. & string	0.58	0.46	0.63	0.40	0.38	0.27
With string only	0.28	0.58	0.54	0.72	0.54	0.56

Table C-13

EXPERIMENTAL GROUP: COMPARISON OF PERFORMANCE ON DARK TARGETS BETWEEN TWO EXPERIMENTAL SUBGROUPS AND THE COMPARABLE CONTROL FOR STARLESS ILLUMINATION

Subgroup	Illumination[a]			Dark Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
Control	Up to 48	32	?	17	17.89	9.29	65
B	32- 129	42	61	31	32.25	12.50	20
E	32- 55	32	34	21	24.57	9.31	14

Results of Analysis of Variance and *t* Tests

Control, B, and E: Variance ratio = 15.82 (p = .001)

Control, B, and E Matrix (from *t* tests):

	Cl	B	E
Cl		.001	.05
B			.05
E			

[a]Illumination expressed in millionths of a foot candle.

Table C-14

EXPERIMENTAL GROUP: COMPARISON OF PERFORMANCE ON DARK TARGETS BETWEEN FIVE EXPERIMENTAL SUBGROUPS AND THE COMPARABLE CONTROL FOR STARLIGHT ILLUMINATION

Subgroup	Illumination[a]			Dark Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
Control	49– 254	84	90	23.0	25.78	11.76	135
A	63– 260	80	104	24.0	31.05	18.99	19
B	92– 101	96	96	42.5	42.00	16.14	20
C	73– 80	76	77	22.0	24.53	15.82	19
D	55– 92	69	72	17.0	20.68	12.79	19
E	76– 112	80	85	26.0	30.27	17.73	15
A′	32– 200	60	69	27.0	31.18	14.60	17

Results of Analysis of Variance and *t* Tests[b]

Control, A, B, C, D, and E: Variance Ratio (F) =6.13 (p=.001)

Control, A, B, C, D, and E Matrix (from t tests):

	C1	A	B	C	D	E
C1		NS	.001	NS	NS	NS
A			.02	NS	.05	NS
B				.001	.001	.02
C					NS	NS
D						.05

[a]Illumination expressed in millionths of a foot candle.
[b]NS equals not statistically significant at probability of .05.

Table C-15

EXPERIMENTAL GROUP: COMPARISON OF PERFORMANCE ON DARK TARGETS BETWEEN THREE EXPERIMENTAL SUBGROUPS AND THE COMPARABLE CONTROL FOR MOONLIGHT ILLUMINATION

Subgroup	Illumination[a]			Dark Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
Control	255 on Up	7000+	?	61.0	62.39	22.11	196
A	440-6220	5620	3881	47.0	48.53	17.96	17
B	890-7000	5620	4358	56.5	58.75	16.80	20
E	580-6220	5620	3824	54.5	57.28	13.58	14

Results of Analysis of Variance

Control, A, B, and E: Variance Ratio (F) = 2.50 (Not Sig.)

[a]Illumination expressed in millionths of a foot candle.

Table C-16

EXPERIMENTAL GROUP: COMPARISON OF PERFORMANCE ON FLASHING TARGETS BETWEEN FIVE EXPERIMENTAL SUBGROUPS AND THE COMPARABLE CONTROL FOR ALL ILLUMINATION

Subgroup	Illumination[a]			Flashing Target Scores			N
	Range	Median	Mean	Median	Mean	SD	
Control	Up to 500	57	87	2	2.69	2.79	198
A	50– 76	69	67	3	5.59	4.26	17
B	48– 101	76	77	5	8.40	8.08	20
C	50– 92	60	64	2	3.00	2.47	19
D	50– 69	52	53	2	2.58	1.70	19
E	50– 80	76	72	3	2.27	1.91	15

Results of Analysis of Variance, *t* Tests, and Median Tests

Control, A, B, C, D, and E: Variance Ratio (F) = 11.98 (p = .001)

Control, A, B, C, D, and E Matrix (from t tests):

	C1	A	B	C	D	E
C1		.01	.001	NS	NS	NS
A			NS	NS	NS	NS
B				.02	.01	.01
C					NS	NS
D						NS

Control, A, B, C, D, and E Matrix (from median tests):

C1	A	B	C	D	E	
	.01	.02	NS	NS	NS	C1

[a]Illumination expressed in millionths of a foot candle.

Table C-17

EXPERIMENTAL GROUP: EFFECT OF CHANGES IN ILLUMINATION AND IN RANGE FOR SPECIAL METHOD B

Illumination	Mean Dark Target Scores					
	Range in Yards					
	25	35	45	55	65	75
Starless	14.10	8.90	6.20	2.95	0.10	0.00
Starlight	14.15	12.10	9.10	5.75	0.90	0.00
Moonlight	15.45	13.65	9.95	,.55	6.15	5.00

Illumination	Mean Flashing Target Scores					
	Range in Yards					
	85	95	105	115	125	135
Over-all	0.90	1.20	1.25	1.80	1.10	2.15

ACKNOWLEDGMENTS

MOONLIGHT II was the kind of research task that is truly a cooperative venture. Many agencies, both military and civil, and many different individuals were instrumental in its successful completion. For this reason the following acknowledgments are in order:

To The Infantry Center for personnel and logistical support, and for engineering support in construction and maintenance of the experimental night firing range; to The Infantry School for military technical assistance, and for supplying facilities and instructors for night vision training; to the 47th Infantry Division for training parts of the Control and Experimental Groups under Army Training Programs Numbers 21-114 and 7-600-1; to the 9th Infantry Division for military technical advice; to Personnel Research Branch, The Adjutant General's Office for testing the night and day vision abilities of all subjects, to the U.S. Army Engineer Research Laboratory for furnishing radium-spot photometers for the accurate measurement of low natural illuminations and to Tulane University for calibration of research personnel on these instruments; to Army Field Forces Board No. 3 for furnishing T-37 flash hiders; to the Army Participation Group, Office of Naval Research Special Devices Center for advice on training aids; to the Armed Forces - National Research Council Vision Committee for scientific technical advice; and last, but certainly not least, to all the individual infantry soldiers who participated as subjects or as co-workers in this experiment.